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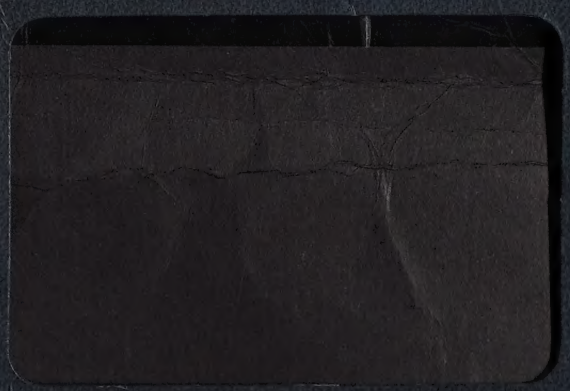
FLUKE®

Instruction Manual



FLUKE®

Instruction Manual

Model

2240A

Data Logger

VIKING LABORATORIES INC.

P/N 427948

JANUARY 1977

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident or abnormal conditions of operations.

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If any failure occurs, the following steps should be taken:

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2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

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The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

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John Fluke Mfg. Co., Inc., • P.O. Box 43210 • Mountlake Terrace, Washington 98043

Rev. 9/78

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Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 2240A Data Logger, in its basic form, is a processor and recorder which is expandable, through the use of optional plug-in modules, into a user-designed data acquisition system capable of servicing up to 1000 channels of guarded analog data. The basic unit is contained within a mechanical housing and consists of a front-mounted control panel, a digital display, a digital printer, a power supply, the control logic required to interface the basic unit with a full complement of options, and a series of pcb and module slots designed to accommodate a number of plug-in options. To form an operational data acquisition system, the 2240A must be equipped with at least one each of the three following options: a scanner (Option —05 or —06), a scanner input connector (Option —07 or —08), and an A/D Converter (Option —09 or —10).

1-3. The front panel of the 2240A features all of the controls necessary to operate the unit with a full complement of optional plug-ins. The controls consist primarily of push button switches which are separated into 10 unique groups. Five groups perform control functions and five groups are dedicated to programming the 2240A. The control group includes: Power, OUTPUT CONTROL, PROGRAM LIST, SCAN CONTROL and DISPLAY CONTROL. The Program groups include: TIME ENTRY, SCAN FORMAT, PROGRAMMING (CHANNEL and LIMITS), ADVANCE ADDRESS and DATA ENTRY.

1-4. The 2240A is energized, and all switches in the five control groups are enabled when the POWER switch is set to either POWER ON or KEYBOARD PROGRAM DISABLE. If channel programming data has been previously entered into memory (via the front panel programming switches), any one of four unique scan modes (single, interval, monitor or continuous) can be started and/or stopped using the SCAN CONTROL switches. During a scan sequence, analog data present at program-selected channels is measured and displayed at the 2240A front panel. When desired, this measurement data can also be recorded on either the internal printer and/or an external recording device. The recording devices to be used and the type of data to be recorded are

selected by the OUTPUT CONTROL and the SCAN CONTROL switch groups. While measurement data is being recorded, alternate forms of data (date and time, and monitor channel) can be selected and displayed by depressing the appropriate switches in the DISPLAY CONTROL group. Similarly, an alternate form of data, program list, can be recorded when the SCAN CONTROL switches are reset and the internal printer is enabled. When the PROGRAM LIST switch is depressed under these conditions, the contents of the keyboard controlled program-memory is recorded on the internal printer.

1-5. The programming switch groups are enabled when the POWER switch is set to POWER ON. Program data is manually entered via the DATA ENTRY keyboard and the specific kind of data to be entered is determined by selecting it from either the TIME ENTRY, SCAN FORMAT or PROGRAMMING (CHANNEL, LIMITS) switch groups. Time is entered in days, hours, minutes and seconds, and is easily synchronized to the true time-of-day. The scan format can be randomly programmed to define: 6 digits of fixed data, first and last channel in a scan sequence, time interval between the start of scan sequences when the interval scan control mode is initiated, and the single channel to be monitored when the monitor scan control mode is initiated. Channel programming switches enable unique measurement functions and measurement limits to be assigned to each channel in the scan format. If one or more channels in the scan format are not to be used, a skip function can be programmed. Limits programming (Options —21 and —22) switches enable up to 30 unique 5-digit limit values (including HI/LO sense and polarity) to be programmed. Each limit is assigned a unique address code from 1 to 30, and any one of the limit values assigned to codes 1 through 15 and/or 16 or 30 can be assigned to any channel by entering the appropriate address codes while programming channel data.

1-6. The digital display is functionally two separate displays which are used for visually presenting the current measurement channel (three digits) and the current measurement data for that channel (polarity, plus five digits and a decimal point). During a normal scan sequence (first channel-to-last channel), the measurement channel is incrementally advanced as each channel measurement is completed, and continues to advance after each measurement until the last selected channel, (000 up to 999) is scanned. A series of annunciators complement the display and indicate the selected measurement function (volts, millivolts, temperature) for the channel indicated. The display is also used during the scan intervals to present the current date and time, and during programming sequences to display program data.

1-7. The printer employed in the 2240A is the Seiko Model 102. It is a medium-speed ink impression line printer capable of recording data at a maximum rate of 2.5 lines per second. Sixteen data columns are available. However, the print format for a scan sequence is fixed, as described in Section 2. Ordinary 2¼-inch fan-fold adding machine paper is used as the recording medium. A front-panel drawer is provided for both housing and take-up of the self-stacking fan-fold paper.

1-8. The power supply provided with the 2240A is capable of servicing both the basic unit and a full complement of options. Input power requirements are 100, 115 or 230V ac ±10%, 50 or 60 Hz, 50 watts maximum. The desired combination of line voltage and frequency should be specified at the time of purchase.

1-9. The control logic of the 2240A includes all of the circuitry necessary to accommodate a full complement of 2240A options. Two important features of the control logic are: the program memory and the guard crossing. The program memory is impervious to the line power interruption and can be maintained for several years after the 2240A is switched OFF. The memory is sustained by a set of lithium batteries which are switched into operation when the line power is removed. The guard-crossing circuit electrically isolates the operation of the scanner blocks (Option —05 or —06) and the analog portion of the measurement circuit (A/D Converter, Option —09 or —10) from the digital control and external equipment interface section of the 2240A.

1-10. Several options and accessories are available for use with the 2240A. The options, their quantity limitations and their installation requirements (factory or field) are listed in Table 1-1. Table 1-2 provides a description of the sub options included in —12, —13 and -14 series of options, and Table 1-3 describes the available 2240A accessories. Descriptions of the most commonly used options (—05, —06, —07, —08, —09, —10 and —11) and accessories (all except 2201A, 2202A and 2203A) are included in Section 6 of this manual. Descriptions of the other options and accessories are supplied separately (when the option or accessory is purchased) and most are designed as subsectional inserts for Section 6 of this manual. The 2201A, 2202A and 2203A series of scanner chassis are documented in separate stand-alone instruction manuals.

1-11. SPECIFICATIONS

1-12. Specifications for the Model 2240A Data Logger and its most-used options (i.e., Options —05, —06, —07, —08, —09, —10 and —11) are contained in Table 1-4 and 1-5, respectively. Specifications for other options are supplied in the appropriate option subsection in Section 6, Options and Accessories.

Table 1-1. 2240A Option Information

FUNCTION	OPTION #	DESCRIPTION	QUANTITY USED IN 2240A		FACTORY OR SERVICE CENTER INSTALLATION REQUIRED?
			Max	Min	
Input Connectors (10 channels each; at least one required per system)	—07	Solder Pin Connector	6	1	*No
	—08	Isothermal Block Connector			
	—28	Current Transmitter, 1-5 mA			
	—29	Current Transmitter, 0-20 mA			
	—30	Current Transmitter, 10-50 mA			
Scanners (10 channels each; at least one required per system)	—05	General Purpose Scanner	6	1	*No
	—06	Low Level Scanner			
A-D Converters (one required per system)	—09	General Purpose A-D	1	1	Yes
	—10	High Performance A-D			
Scaling and Linearization	—11	Temperature Measurement	1	0	Yes
	—25	Custom Scaling	4		
	—26	Multiple Custom Scaling	1		
	—27	Engineering Units	4		
Program Memories	—20	Program Memory Expander	1	0	Yes
Digital Limits	—21	Alarm Set — 7 Single Limits	2	0	Yes
	—22	Alarm Set — 15 Single Limits			
	—23	Alarm Set Point Output	1	0	*No
Digital Input Interface Digital Output Interface Series (See Table 1-2)	—16	Digital Input Interface	3	0	*No
	—12	ITTY RS-232C Interface			
	—13	Paper Punch Interface			
	—14	Magnetic Tape Interface			

**Customer can install.*

Table 1-2. Description of —12, —13 and —14 Series Options

OPTION NO.	DESCRIPTION	RECORDER TYPE	OPTION CONFIGURATION		
			Recorder	Cable	Interface PCB
—12B	ASR33 Interface	Teleprinter	O	●	●
—12C	TI733 KSR/RO Interface		O	●	●
—12D	RS-232C General Purpose Interface		O	●	●
—12E	Techtran 8410 Cassette and Interface	Cassette	●	●	●
—12F	Techtran 8410 Cassette Recorder		●	O	O
—12G	Techtran 8400 Cassette Recorder		●	O	O
—12H	Techtran Cassette Recorder Interface		O	●	●
—12J	Techtran Cassette Rackmount Kit		O	O	O
—13A	Facit 4070 (Bench Top) and Interface	Paper Tape Punch	●	●	●
—13B	Facit 4070 (Rack Mounted) and Interface		●	●	●
—13C	Facit 4070 Interface		O	●	●
—13D	Facit 4203.0005 and Interface	Cassette	●	●	●
—13E	Facit 4203.0005 Interface		O	●	●
—14A	Kennedy 1600/5 and Interface	Magnetic Tape	●	●	●
—14B	Kennedy 1610/5 and Interface		●	●	●
—14C	Kennedy 1600/360 and Interface		●	●	●
—14D	Kennedy 1610/360 and Interface		●	●	●
—14E	Kennedy 1600/5 or 1610/5 Interface		O	●	●
—14G	Kennedy 1600/360 or 1610/360 Interface		O	●	●

Table 1-3. 2240A Accessories

MODEL NO.	DESCRIPTION	FUNCTION
2201A	Scanner Chassis	Houses up to twelve —05 or —06 scanners. Operates up to 50-feet from 2240A.
2202A	Remote Scanner Chassis	Houses up to ten —05 or —06 scanners. Operates up to 1500-feet from 2240A.
2203A	RTD Scanner Chassis	Houses up to ten —04, —05 or —06 scanners. Operates up to 1500-feet from 2240A.
2200A-7007	Interface Connector, Blank (50-pin)	I/O connector for use with option —16 or —23.
2200A-7006	General Purpose Interface Cable (6-foot)	I/O connector and cable for use with option —16 or —23. (Connector on one end only.)
2200A-7005	Service Extender Cable Set	Extends most 2240A pcb's for servicing.
MO7-205-600	Rack Mounting Kit	Rack mounts 2240A in 19" wide console.
MOO-280-610	Rack Slide Kit, 24" Cabinet	Slide mounts 2240A in 19" (W) x 24" (D) console.
2010A-7013	Fan-Fold Printer Paper (1 dozen)	Replacement printer paper.
2010A-7014	Printer Ribbon (1 dozen)	Replacement printer ribbon.

Table 1-4. 2240A Specifications

OPERATIONAL

Channel Capacity .....60 channels, expandable to 1000 channels using the Model 2201A, 2202A, and/or 2203A Scanner Chassis.

Scanning Speed
- Option —09 .....2.5 channels/sec maximum
- Option —10 .....2.5 or 15 channels/sec maximum (internally selectable)

Channel Display .....3 digits

Data Display
- Numeric .....Polarity plus 5 digits
- Annunciator .....mV, V, temperature, date and time

Scan Controls .....Push button switches initiate the following scan sequences.
- SINGLE
- INTERVAL
- MONITOR
- CONTINUOUS
- REMOTE
- STOP/RESET

Output Controls .....Push button switches control the operation of the internal printer and/or external recorder.

PRINTER ENABLE	EXTERNAL ENABLE
ALL DATA	ALL DATA
LIMIT DATA	LIMIT DATA
INTERVAL DATA	INTERVAL DATA
PAPER ADVANCE	

Table 1-4. 2240A Specifications (continued)

Display Control	Push button switches select one of the following functions for display: ALL CHANNELS MONITOR CHANNEL DATE AND TIME
Time Entry	Push button switches enable keyboard entry of 3-digit date (DAY) or time (HR, MIN, SEC). Clock operates from 50 or 60 Hz line frequency.
Scan Format	Push button switches enable keyboard entry of following scan information: FIXED DATA FIRST CHANNEL LAST CHANNEL INTERVAL-HR, MIN, SEC. MONITOR CHANNEL
Program List	Push button switch enables the printer to record contents of program memory. This includes: channel number, range and function, limits address and limit values, fixed data, monitor channel, time of year, and interval.
Programming	Push button switches enable keyboard entry of unique program data for each of the channels, this includes: CHANNEL Address ..... 000-999 Function ..... 40 mV, 400 mV, 4V, 40V, T1, T2, T3, T4 and Skip Address Limit A ... 1 through 15 Address Limit B ... 16 through 30 LIMITS Address ..... 1 through 30 Sense ..... High or Low Polarity ..... + or - Value ..... -39990 to +39990
Advance Address	Push button switch for step advancing channel, limit or monitor channel addresses.
Digital Printer	
Print Speed	2.5 lines/sec.
Print Mechanism	Seiko Model 102
Column Capacity	16
Program Memory	Non-volatile with minimum life of 5 years (program data is retained while power is turned off).
Options Required for Operation	One a/d converter (Option —09 or —10). At least one scanner pcb (Option —05 or —06). At least one input connector (Option —07 or —08).

GENERAL

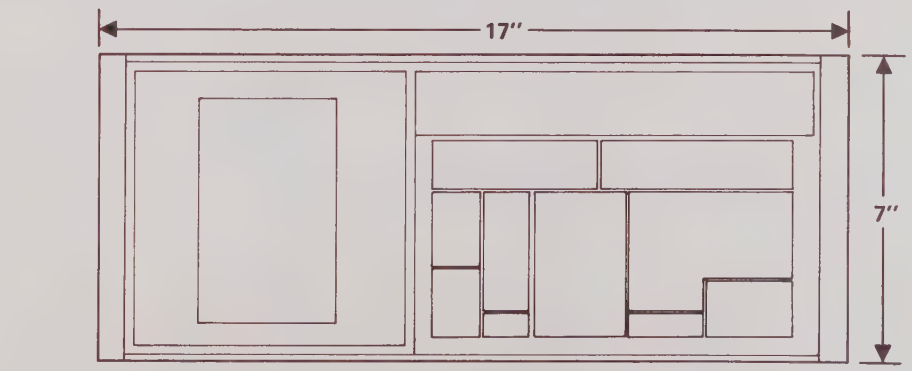
Dimensions	7 in. high X 17 in. wide X 22.47 in. deep (17.78 cm X 43.18 cm X 57 cm) See outline drawing in Figure 1-1.

Table 1-4. 2240A Specifications (concluded)

Weight	Approximately 40 pounds without options (18.144 kg)
Power	Specify one of the following combinations at time of purchase: (50 watts maximum) 100V ac ±10%, 50 Hz 100V ac ±10%, 60 Hz 115/230V ac ±10%, 50 Hz 115/230V ac ±10%, 60 Hz
Warm-Up Time	One hour for full accuracy. Accuracy is reduced by 0.02% of range at time of the initial turn-on.

ENVIRONMENTAL

Temperature	
Operating	0°C to +50°C
Storage	-40°C to +60°C
Humidity	80% relative humidity, non-condensing, 0 to +35°C 70% relative humidity, non-condensing, +35 to +50°C
Shock and Vibration	Meets MIL-T-28800A, Class 4



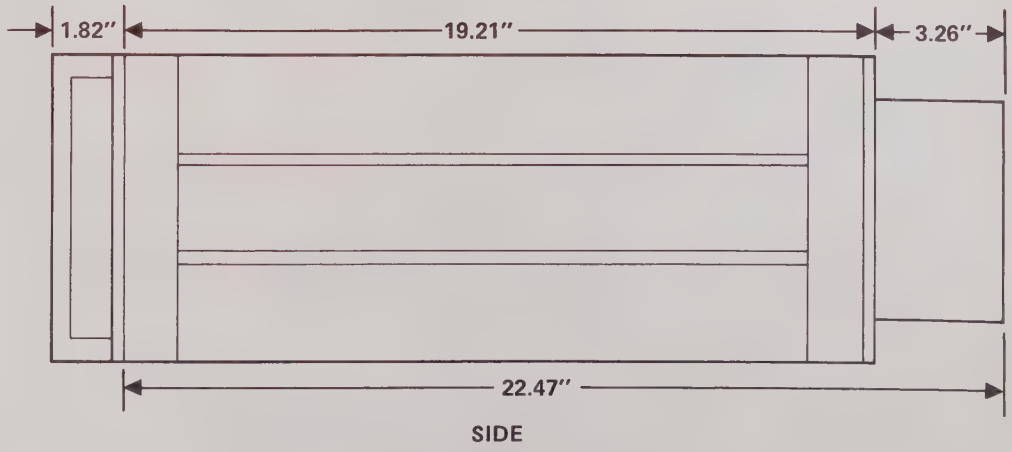


Figure 1-1. Outline Drawing

Table 1-5. Option Specifications (—05, —06, —07, —08, —09, —10, and —11)

OPTION —05

GENERAL PURPOSE SCANNER

Channel Relay	10 low thermal-emf reed relays
Poles Per Channel	Two (form A)
Shield Switching	One switch for 10 channels
Voltage Offset	≤10 μV
Input Voltage Limit*	170V dc or peak ac maximum
Common Mode Voltage Limit (Voltage between chassis and any input)	350V dc or peak ac maximum provided the Input Voltage Limit is not exceeded.

**Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.*

OPTION —06

LOW LEVEL SCANNER

Channel Relays	10 low thermal-emf reed relays
Poles per Channel	Three (includes shield switch)
Shield Switching	One switch per channel
Voltage Offset	≤1 μV
Input Voltage Limit*	170V dc or peak ac maximum
Common Mode Voltage Limits (Voltage between chassis and any input)	350V dc or peak ac provided the input Voltage Limit is not exceeded.
Over-Current Protection	470Ω resistor in series with each input

**Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.*

OPTION —07

SOLDER PIN CONNECTOR

Compatibility	Mates with either the —05 or —06 scanners
Terminal Style	Solder type
Number of Terminals	30 (High, Low, Shield per channel)

OPTION —08

ISOTHERMAL BLOCK CONNECTOR

Compatibility	Mates with either the —05 or —06 scanners
Terminal Style	Screw type
Number of terminals	30 (High, Low, Shield per channel)
Temperature Gradient between any terminals	±0.05°C maximum
Reference Junction Stability	±0.005°C per ° (0°C to 50°C)

OPTION —09

GENERAL PURPOSE A/D CONVERTER

Compatibility	Specifications apply when used with the General Purpose Scanner (Option —05)
Measurement Method	Dual slope integration over 5 line cycles
Measurement Speed	3 readings per sec with integration over 5 line cycles
Dynamic Range	40,000 counts (0-39,999)

Table 1-5. Option Specifications (continued)

Ranges	±400 mV (10 μV resolution) ±4V (100 μV resolution)
Input Impedance	>200 MΩ. Source impedance must be <4 kΩ to incur no settling errors. See Figure 1.
Zero Stability	Automatic zero
Overload without Damage	170V dc or peak ac any range
Overrange Indication	Front panel display, printer and output indicate overrange
Common Mode Rejection	140 dB at 50 and 60 Hz ±0.1%, 120 dB at dc with 1 kΩ unbalance
Common Mode Voltage	Maximum of 350V dc or peak ac
Normal Mode Rejection	70 dB at 50 and 60 Hz ±0.1%
Accuracy (System*)	
90 Days (20°C to 30°C)	±(0.02% reading +0.005% range +10 μV)
1 Year (15°C to 35°C)	±(0.03% reading +0.01% range)
Temperature Coefficient (0°C to 20°C and 30°C to 50°C)	±(0.002% reading +0.001% range)/°C

**System accuracy includes all instrument errors such as a-d errors, scanner errors, power supply, internal warm-up, etc.*

OPTION —10

HIGH PERFORMANCE A/D CONVERTER

Compatibility	Specifications apply when used with the Low Level Scanner (Option —06)
Measurement Method	Dual slope integration over 5 line cycles (slow speed) or 1 line cycle (fast speed)
Measurement Speed	3 readings per sec with integration over 5 line cycles (slow speed) 15 readings per sec with integration over 1 line cycle (fast speed) Selectable by internal switch
Dynamic Range	40,000 counts (0-39,999)
Ranges	±40 mV (1 μV resolution) ±400 mV (10 μV resolution) ±4V (100 μV resolution) ±40V (1 mV resolution)
Input Impedance	>200 MΩ on all ranges except 40V range; input impedance is 10 MΩ on 40V range. Source impedance must be <4 kΩ to incur no settling errors, except the 40V range which has no limitation for settling errors. See Figure 1.
Zero Stability	Automatic zero
Overload without Damage	170V dc or peak ac any range
Overrange Indication	Front panel display, printer and output indicate overrange
Common Mode Rejection	140 dB at 50 and 60 Hz ±0.1%, 120 dB at dc with 1 kΩ unbalance at slow speed. 110 dB at 50 and 60 Hz ±0.1%, 120 dB at dc with 1 kΩ unbalance at fast speed.

Table 1-5. Option Specifications (continued)

Common Mode Voltage	Maximum of 350V dc or peak ac
Normal Mode Rejection	70 dB at 50 and 60 Hz ±0.1% slow speed 55 dB at 50 and 60 Hz ±0.1% fast speed
Accuracy (System *)	
90 Days (20°C to 30°C)	±(0.01% reading +0.005% range +3 μV) slow speed ±(0.01% readings +0.008% range +5 μV) fast speed
1 Year (15°C to 35°C)	±(0.02% readings +0.01% range +5 μV) slow speed ±(0.02% readings +0.015% +7 μV) fast speed
Temperature Coefficient ..... (0°C to 20°C and 30°C to 50°C)	±(0.001% readings +0.001% range)/°C
Reference Voltage for ..... Self Check	Available via 2 jacks at the rear of instrument. These voltages can be used for initial checkout by wiring to scanner inputs for system self check.
Reference Voltages	2V, 0.02V
Reference Accuracy	90 days, 20°C—30°C ±0.02%
Reference Stability	±0.003%/°C ±0.003%/yr

**System accuracy includes all instrument errors such as a-d errors, scanner errors, power supply, internal warm-up, etc.*

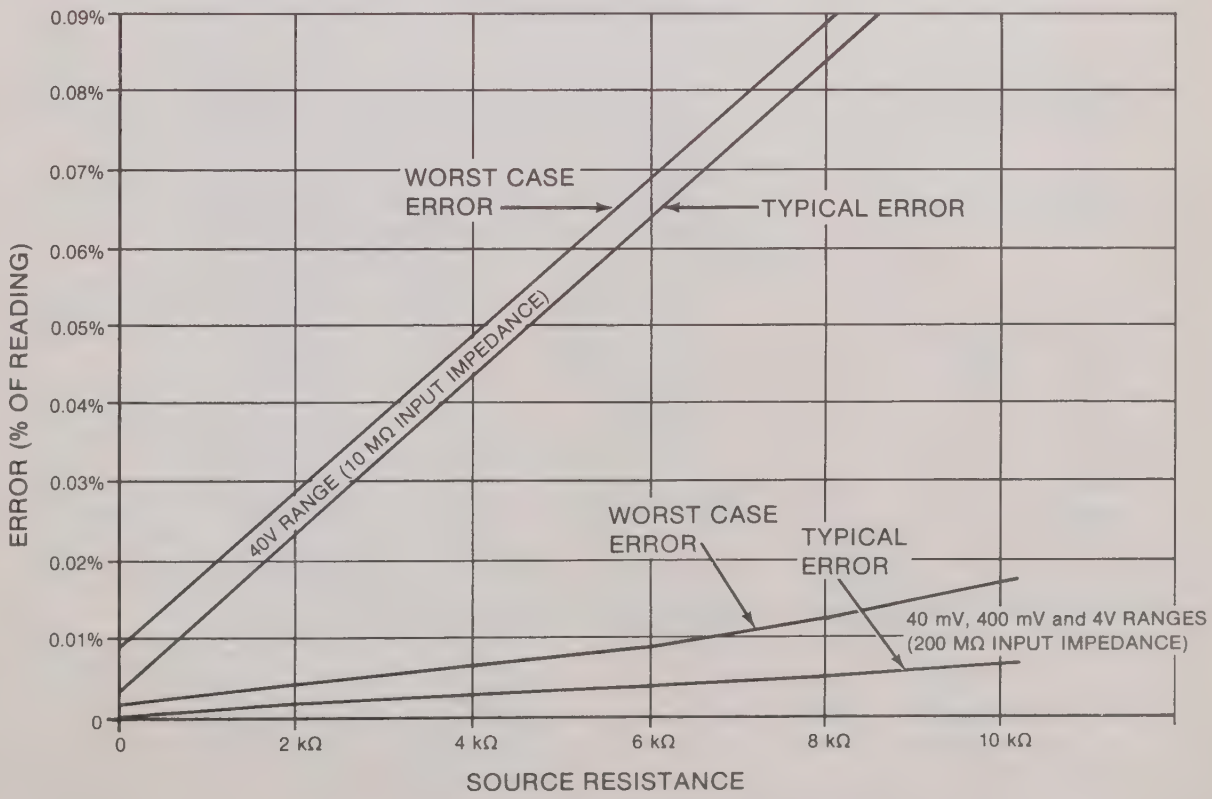


Figure 1. Error (% of Reading) versus Source Resistance

Table 1-5. Option Specifications (continued)

OPTION —11
TEMPERATURE AND SCALING OPTION

Compatible Probe Types ..... A total of four of the listed probe types can be specified. However, not more than one from group B can be specified unless Option —26 (Multiple Group B PROM Assembly) is added.

Group A ..... J, K, T, R, S (thermocouples)

Group B ..... E, B, C, G, D (W3), RTD (385 Platinum), RTD (392 Platinum), Current Transmitter (0—100%), Custom Scaling (Option —25).

Linearization ..... Digital, 31 to 33 optimized segment lengths.

Open Circuit Detection ..... Source impedance of greater than 7.5k ±2.5 kΩ and capacitance ≤0.01 μF is defined as an open circuit.

Open Circuit Indication ..... Front panel display, printer and all serial output devices provide open circuit indications.

Temperature Scale Selection ..... Switch is provided on the inside of the 2240A for selecting either the °C or °F temperature scale for measurement, display and recording purposes.

Reference Junction Compensation ..... Automatic from 0° to +50°C. (Less than ±0.05° error from 15 to 35°C for J, K, and T type thermocouples.)

Resolution Linearization ..... Temperature resolution system specifications of either 1° or 0.1° apply when the following options are used:

	0.1°	1.0°
A/D Converter, Option	—10	—09
Scanner, Option	—06	—05
Input Connector, Option	—08	—08

System Specification	0.1°	1.0°
Resolution	See Table 1	See Table 2
Accuracy		
Conformity to NBS Table		

Temperature Coefficient ..... ±(0.0015% of reading +0.01°)/°C
(0 to 20°C and 30 to 50°C)

Table 1-5. Option Specifications (concluded)

Table 1. System Accuracy, 0.1° Resolution (using Low Level Scanner and High Performance A-D Converter)

Temperature Range Per Thermocouple Type	Worst Case Resolution	NBS Conformity	System Accuracy(±) 90 Days 77°F ±9°F 25°C ±5°C **Slow	***Fast	1 Year 77°F ±18°F 25°C ±10°C ** Slow
J Iron-Constantan					
°F -332 to -200	0.2°	0.15°	1.0°	1.2°	1.2°
-200 to 32	0.1°	0.15°	0.8°	1.0°	1.0°
32 to 1400	0.1°	0.1°	0.8°	0.7°	0.7°
1400 to 2200	0.1°	0.3°	0.8°	0.9°	1.0°
°C -202 to 0	0.1°	0.083°	0.6°	0.7°	0.7°
0 to 760	0.1°	0.055°	0.4°	0.5°	0.5°
760 to 1205	0.1°	0.166°	0.5°	0.6°	0.6°
K Chromel-Alumel					
°F -332 to -300	0.3°	0.175°	1.2°	1.5°	1.5°
-300 to -200	0.2°	0.175°	1.0°	1.3°	1.3°
-200 to 32	0.2°	0.175°	0.8°	1.1°	1.1°
32 to 500	0.1°	0.15°	0.7°	0.8°	0.8°
500 to 2500	0.1°	0.15°	0.8°	0.9°	1.0°
°C -202 to -172	0.2°	0.1°	0.7°	0.8°	0.9°
-172 to -130	0.1°	0.1°	0.6°	0.7°	0.8°
-130 to 0	0.1°	0.1°	0.5°	0.6°	0.6°
0 to 260	0.1°	0.083°	0.4°	0.5°	0.5°
260 to 1370	0.1°	0.083°	0.5°	0.6°	0.6°
T Copper-Constantan					
°F -332 to -300	0.2°	0.1°	1.1°	1.5°	1.5°
-300 to -200	0.1°	0.1°	1.0°	1.3°	1.3°
-200 to 32	0.1°	0.1°	0.9°	1.1°	1.1°
32 to 750	0.1°	0.1°	0.7°	0.8°	0.8°
°C -202 to -130	0.1°	0.055°	0.6°	0.8°	0.8°
-130 to 0	0.1°	0.055°	0.5°	0.7°	0.7°
0 to 400	0.1°	0.055°	0.4°	0.5°	0.5°
E Chromel-Constantan					
°F -332 to -240	0.2°	0.175°	0.9°	1.1°	1.1°
-240 to 32	0.1°	0.175°	0.8°	1.0°	1.0°
32 to 500	0.1°	0.11°	0.6°	0.7°	0.7°
500 to 1830	0.1°	0.11°	0.6°	0.7°	0.7°
°C -202 to 0	0.1°	0.1°	0.5°	0.6°	0.6°
0 to 260	0.1°	0.1°	0.4°	0.5°	0.5°
260 to 960	0.1°	0.07°	0.4°	0.5°	0.5°
R Pt. 13% Rhodium					
°F 32 to 90	0.4°	0.2°	2.8°	4.0°	4.0°
90 to 500	0.3°	0.2°	2.6°	3.8°	3.8°
500 to 3200	0.2°	0.2°	1.8°	2.4°	2.5°
°C 0 to 260	0.2°	0.1°	1.6°	2.3°	2.3°
260 to 350	0.2°	0.1°	1.0°	1.4°	1.4°
350 to 1760	0.1°	0.1°	1.0°	1.4°	1.4°
S Pt. 10% Rhodium					
°F 32 to 90	0.4°	0.2°	2.8°	4.0°	4.0°
90 to 500	0.3°	0.2°	2.6°	3.8°	3.8°
500 to 3200	0.2°	0.2°	1.8°	2.4°	2.5°
°C 0 to 260	0.2°	0.1°	1.6°	2.3°	2.3°
260 to 550	0.2°	0.1°	1.0°	1.4°	1.4°
550 to 1760	0.1°	0.1°	1.0°	1.4°	1.4°
B Pt. 6% Rhodium versus Pt. 30% Rhodium					
°F 896 to 1800	0.3°	0.14°	2.8°	4.0°	4.0°
1800 to 3308	0.2°	0.14°	2.0°	3.0°	3.0°
°C 480 to 1000	0.2°	0.08°	1.6°	2.4°	2.4°
1000 to 1820	0.1°	0.08°	1.2°	1.6°	1.6°
C* Tungsten 5% Rhenium versus Tungsten 26% Rhenium					
°F 32 to 3632	0.2°	0.18°	1.2°	1.6°	1.6°
3632 to 4208	0.2°	13.5°	15.0°	16.0°	16.0°
°C 0 to 2000	0.1°	0.1°	0.7°	1.0°	1.0°
2000 to 2320	0.1°	7.5°	9.0°	9.5°	9.5°
D* (W3)* Tungsten 3% Rhenium versus Tungsten 25% Rhenium					
°F 32 to 500	0.2°	0.22°	1.4°	1.8°	1.8°
500 to 3632	0.2°	0.22°	1.2°	1.6°	1.6°
3632 to 4208	0.2°	18.4°	20.0°	21.0°	21.0°
°C 0 to 260	0.1°	0.12°	0.8°	1.0°	1.0°
260 to 2000	0.1°	0.12°	0.7°	1.0°	1.0°
2000 to 2320	0.1°	10.2°	12.0°	12.5°	12.5°
G* Tungsten versus Tungsten 26% Rhenium					
°F 410 to 800	0.2°	0.2°	1.8°	2.6°	2.6°
800 to 3632	0.2°	0.2°	1.4°	2.0°	2.0°
3632 to 4208	0.2°	13.8°	15.0°	16.0°	16.0°
°C 210 to 420	0.2°	0.12°	1.1°	1.5°	1.5°
420 to 2000	0.1°	0.12°	0.8°	1.2°	1.2°
2000 to 2320	0.1°	7.1°	8.0°	8.5°	8.5°

Not ANSI Symbol

***Slow Speed ~2.5 readings/sec*

****Fast Speed ~15 readings/sec*

Table 2. System Accuracy, 1.0° Resolution (using General Purpose Scanner and General Purpose A-D Converter)

Temperature Range Per Thermocouple Type	Worst Case Resolution	NBS Conformity	System Accuracy (±) 90 Days 77°F ±9°F 25°C ±5°C **Slow	1 Year 77°F ±18°F 25°C ±10°C **Slow
J Iron-Constantan				
°F -332 to 32	1°	0.15°	3°	4°
32 to 1400	1°	0.1°	2°	3°
1400 to 2200	1°	0.3°	2°	3°
°C -202 to 0	1°	0.083°	2°	3°
0 to 760	1°	0.055°	2°	2°
760 to 1205	1°	0.166°	2°	2°
K Chromel-Alumel				
°F -332 to -200	1°	0.175°	3°	4°
-200 to 32	1°	0.175°	3°	4°
32 to 500	1°	0.15°	2°	3°
500 to 2500	1°	0.15°	2°	3°
°C -202 to -130	1°	0.1°	2°	3°
-130 to 0	1°	0.1°	2°	3°
0 to 260	1°	0.083°	2°	2°
260 to 1370	1°	0.083°	2°	2°
T Copper-Constantan				
°F -332 to -200	1°	0.1°	3°	4°
-200 to 32	1°	0.1°	3°	4°
32 to 750	1°	0.1°	2°	3°
°C -202 to -130	1°	0.055°	2°	3°
-130 to 32	1°	0.055°	2°	3°
0 to 400	1°	0.055°	2°	2°
E Chromel-Constantan				
°F -332 to 32	1°	0.175°	3°	4°
32 to 500	1°	0.11°	2°	3°
500 to 1830	1°	0.11°	2°	3°
°C -202 to 0	1°	0.1°	2°	3°
0 to 260	1°	0.1°	2°	2°
260 to 960	1°	0.1°	2°	2°
R Pt. -13% Rhodium				
°F 0 to 500	4°	0.2°	10°	12°
500 to 3200	2°	0.2°	7°	9°
°C -18 to 260	2°	0.1°	6°	8°
260 to 1760	1°	0.1°	4°	6°
S Pt. -10% Rhodium				
°F 0 to 500	4°	0.2°	10°	12°
500 to 3200	2°	0.2°	7°	9°
°C -18 to 260	2°	0.1°	6°	8°
260 to 1760	1°	0.1°	4°	6°
B Pt. 6% Rhodium versus Pt. 30% Rhodium				
°F 896 to 1800	3°	0.14°	10°	12°
1800 to 3308	2°	0.14°	8°	10°
°C 480 to 100	2°	0.08°	6°	8°
1000 to 1820	2°	0.08°	5°	6°
C* Tungsten 5% Rhenium versus Tungsten 26% Rhenium				
°F 32 to 3632	2°	0.18°	4°	5°
3632 to 4208	2°	13.5°	18°	20°
°C 0 to 200	1°	0.1°	3°	3°
2000 to 2320	1°	7.5°	10°	11°
D* (W3)* Tungsten 3% Rhenium versus Tungsten 25% Rhenium				
°F 32 to 3632	2°	0.22°	4°	5°
3632 to 4208				
°C 0 to 2000	1°	0.12°	3°	3°
2000 to 2320	1°	10.2°	14°	15°
G* Tungsten versus Tungsten 26% Rhenium				
°F 410 to 800	2°	0.2°	6°	7°
800 to 3632	2°	0.2°	4°	5°
3632 to 4208	2°	13.8°	18°	19°
°C 210 to 420	2°	0.12°	4°	4°
420 to 2000	1°	0.12°	3°	3°
2000 to 2320	1°	7.1°	10°	11°

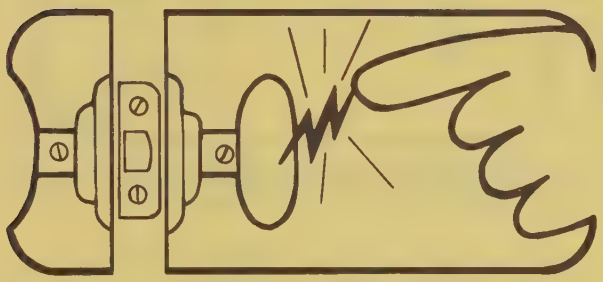
Not ANSI Symbol

***Slow Speed ≈2.5 readings/sec*

static awareness

A Message From

John Fluke Mfg. Co., Inc.

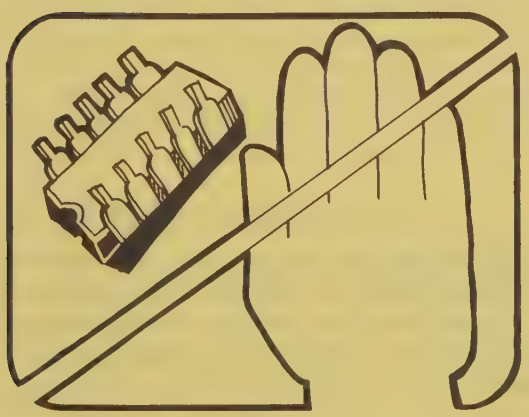


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

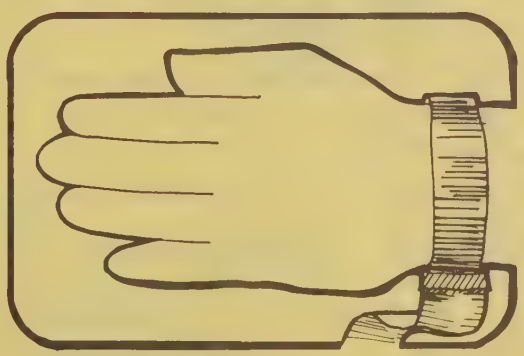
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

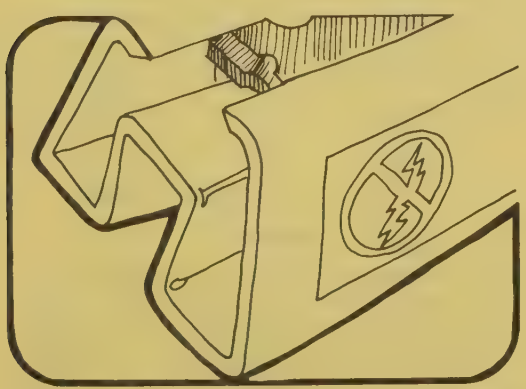
The following practices should be followed to minimize damage to S.S. devices.



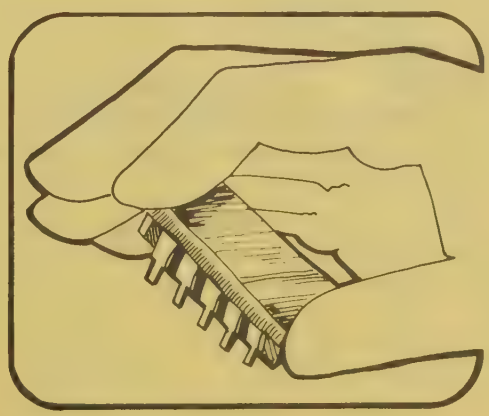
1. MINIMIZE HANDLING



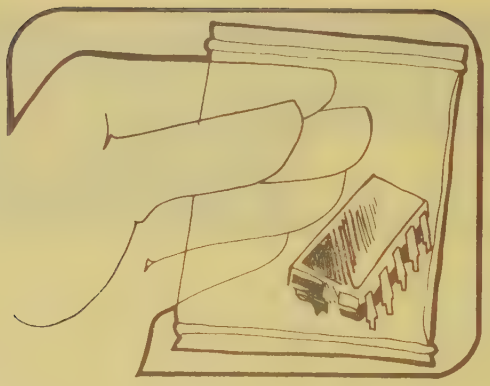
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



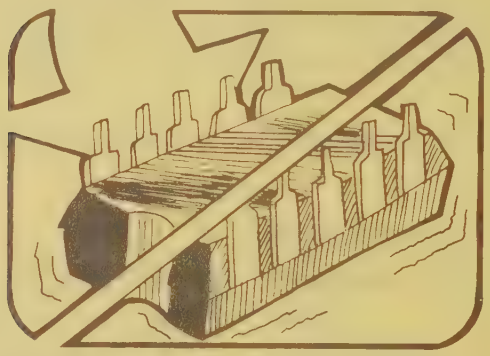
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



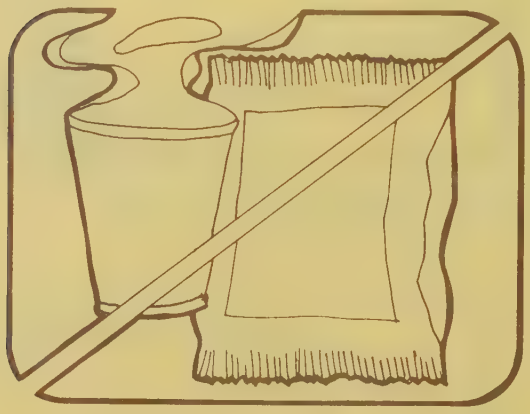
4. HANDLE S.S. DEVICES BY THE BODY



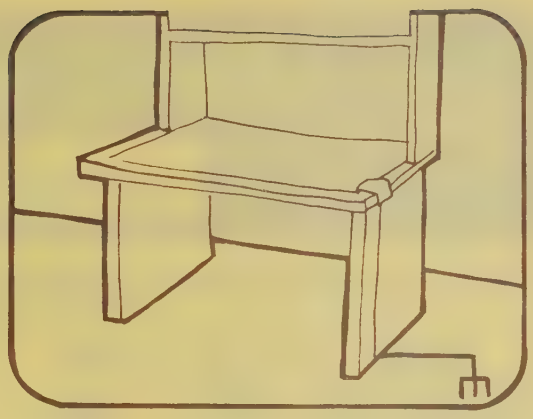
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information concerning the installation and operation of the Model 2240A Data Logger. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation, contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA, 98043, Telephone (206) 774-2211. A list of sales representatives is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The 2240A is packaged and shipped in a foam-packed container. Upon receipt of the instrument, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5. If reshipment of the instrument is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument's model number when requesting a new shipping container.

2-6. INPUT POWER

WARNING

LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2240A IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS AND SCANNER PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

2-7. The 2240A can be operated from either 100, 115, or 230V ac, 50 or 60 Hz line power depending upon the combination specified at the time of purchase. Before connecting the unit to line power, check and, if necessary, set the line-voltage and the line-frequency switches.

a. Remove the top dust cover from the instrument.

b. Locate the line-voltage switch shown in Figure 2-1.

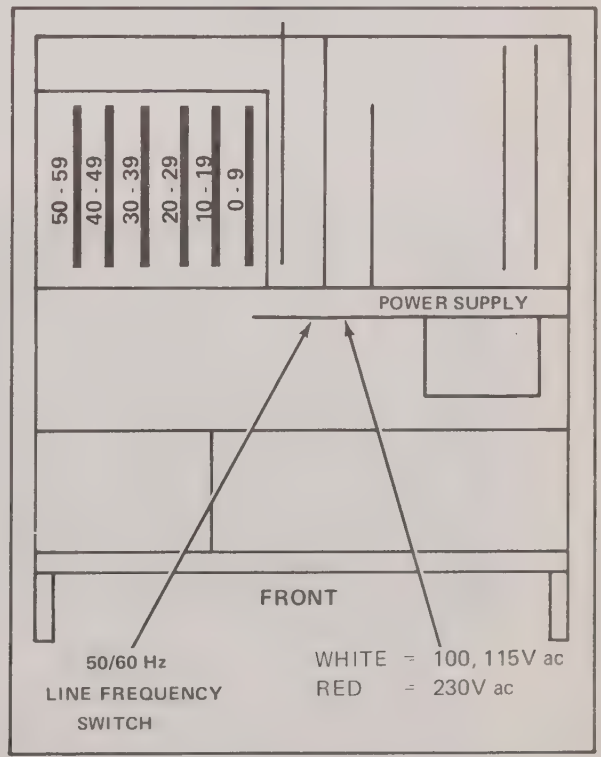


Figure 2-1. Power Supply Voltage and Frequency Switches

c. Refer to the rear panel decal and use a screwdriver to set the slide switch so that the specified voltage (100/115 (white) or 230V ac (red)) appears in the slide aperature.

d. Locate the line frequency switch shown in Figure 2-1.

e. Set the switch to the line frequency (50 or 60 Hz) specified on the rear panel decal.

NOTE

If it becomes necessary to change the line frequency from that originally specified, a crystal on the guard crossing must be changed. Contact your nearest John Fluke Representative or the John Fluke Mfg. Co., Inc.

f. Install the proper fuse in the rear-panel fuse holder.

100V ac — 3/4A Slo-Blo
115V ac — 3/4A Slo-Blo
230V ac — 3/8A Slo-Blo

g. Re-install the top dust cover.

2-8. RACK INSTALLATION

2-9. The 2240A is designed for either bench-top use or for installation in a standard 19-inch equipment rack using the accessory Rack Mounting Kit (John Fluke P/N MO7-205-600). Chassis slides (John Fluke P/N MOO-208-610) can also be installed to facilitate access to the instrument when it is installed in an equipment rack. Information regarding the installation of the rack-mounting accessories is included in Section 6.

2-10. OPERATING FEATURES

2-11. The function and location of all 2240A controls and indicators are shown in Figure 2-2 and described in Table 2-1.

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which should be considered before operating the 2240A.

2-14. AC Line Connection

2-15. The rear-panel, three-prong, U-ground connector permits the 2240A to be connected, through a power cord, to either 100, 115 or 230V ac, 50 or 60 Hz line power. The offset prong on this connector is connected to the 2240A chassis and should be connected, via the power cord, to a high quality earth ground.

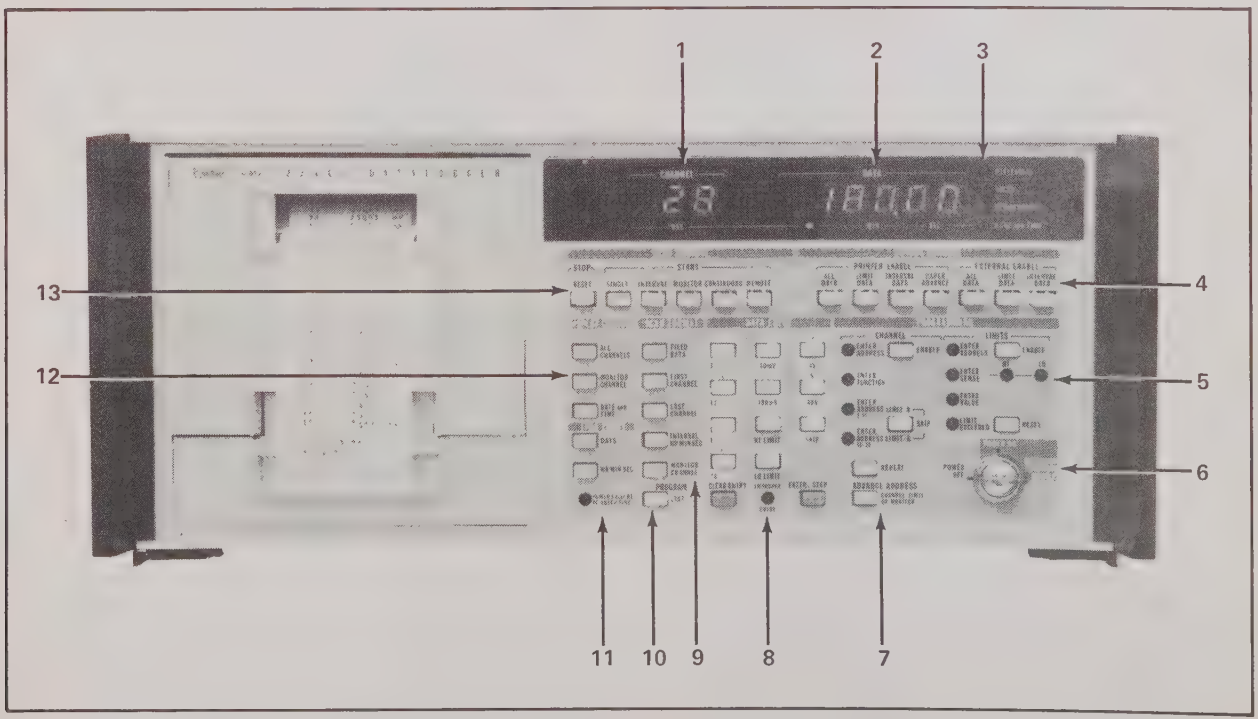


Figure 2-2. 2240A Front Panel Controls and Indicators

Table 2-1. 2240A Front Panel Controls and Indicators

REF. NO.	NAME	FUNCTION
1	CHANNEL/DAY Display	A three digit multi-purpose display which provides a read-out of any one of the following: CHANNEL, DAY or limits address. Channel data is displayed as a three digit number from 000 to 999. Day data is displayed as a three-digit date code from 000 to 999, and can be distinguished from Channel data by a lit DATE AND TIME lamp in the display annunciator group. Limits address data is displayed as a two-digit code from 01 to 30. The left-most digit is blanked to distinguish it from both Channel and Day data.
2	DATA/HR:MIN:SEC Display	A six digit display which provides a read-out of any one of the following: measurement data (voltage, temperature, etc.); time-of-day in hours, minutes and seconds; programmed function; or programmed limit value.
3	Display Annunciator	Four LED's which light on a mutually-exclusive basis to indicate the kind of data currently present on the CHANNEL/DATA display. MILLIVOLTS, VOLTS, and TEMPERATURE indicate the measurement function assigned to the displayed channel. DATE AND TIME indicates that the display is assigned to read the time-of-year (day, hours, minutes, seconds).
4	OUTPUT CONTROL Switches	Seven push button switches that are divided into two groups (EXTERNAL ENABLE and PRINTER ENABLE) to provide individual control over the type of data to be recorded by the printer and any external recording peripherals. Three switches in each group allow selection of either ALL DATA, LIMIT DATA, or INTERVAL DATA. A fourth switch (PAPER ADVANCE) in the PRINTER ENABLE group allows the printer paper to be manually advanced.
5	PROGRAMMING Switches	Two groups of push button switches (CHANNEL and LIMITS) that allow function (voltage, temperature or skip) and limit data to be assigned to each channel. Data is assigned via the DATA ENTRY keyboard, and a program sequence for either channel or limits data is initiated by depressing the ENABLE switch in the appropriate group. A lamp is lit to prompt the entry of the necessary data. Each data entry is completed and the sequence is advanced by pressing the ENTER/STEP switch in the DATA ENTRY switch group.
6	Power Switch	A three-position key-operated switch used to switch the 2240A on or off. In both the POWER-ON and KEYBOARD PROGRAM DISABLE position, the data logger is energized and operational. However, program data can only be entered when the switch is in the POWER ON position. Removing the key in the KEYBOARD PROGRAM DISABLE position prevents tampering with, or accidental destruction of, program data.

Table 2-1. 2240A Front Panel Controls and Indicators (continued)

REF. NO.	NAME	FUNCTION
7	ADVANCE ADDRESS Switch	A push button switch which allows the displayed channel or limits address to be sequentially advanced for programming purposes. Also advances the monitor channel address (when the monitor channel display is enabled) to allow the manual scanning of channels.
8	DATA ENTRY Keyboard	A general purpose push button keyboard for entering variable magnitude and function program data. The keyboard operates in conjunction with the TIME ENTRY, SCAN FORMAT, and PROGRAMMING switch groups. CLEAR ENTRY and ENTER/STEP switches are also provided. An IMPROPER ENTRY lamp lights to indicate that an attempt to enter illegal data has been made.
9	SCAN FORMAT Switches	A series of push button switches that allow the format of a scan sequence to be programmed via the DATA ENTRY keyboard. This includes a fixed data heading, first and last channels, and the time interval between the start of scan cycles when operating in the interval scan control mode. When operating the monitor scan control mode, the MONITOR CHANNEL switch allows the monitored channel to be assigned via the data entry keyboard.
10	PROGRAM LIST Switch	A push button switch which enables the operator to solicit a printout of all limits data and the First-Channel through Last-Channel data in program memory. Prior to pressing the PROGRAM LIST switch, both the RESET switch in the SCAN CONTROL switch group and the ALL DATA switch in the OUTPUT CONTROL group must be depressed. See Figure 2-7 for an example of data listed.
11	TIME ENTRY Switches	Push button switches that allow the date and time to be set via the DATA ENTRY keyboard. Separate switches provide for the entry of either the three-digit day-of-year or the six-digit time-of-day. A power failure lamp is also included in this group to indicate the occurrence of a power interruption after the time has been set.
12	DISPLAY CONTROL Switches	Three push button switches that provide for the manual selection of displayed data during a scan sequence. The switches will not interrupt the scan sequence or the recorded data. ALL CHANNELS — Selects all channels in a scan sequence for display. If the INTERVAL scan control mode is enabled, the time-of-year is displayed between scans. MONITOR CHANNEL ..... Selects the programmed monitor-channel data for display, without altering the scan sequence. DATE & TIME ... Selects the time-of-year clock for display.

Table 2-1. 2240A Front Panel Controls and Indicators (concluded)

REF. NO.	NAME	FUNCTION
13	SCAN CONTROL Switches	Six mutually-exclusive push button switches which provide for the selection of a scan control mode. STOP/RESET .. Terminates any previously selected scan control sequence. SINGLE ..... Initiates the SINGLE scan control mode; i.e., one scan sequence is executed. INTERVAL ..... INTERVAL scan control mode. The scan sequence is repeated at a programmed time interval. MONITOR..... Initiates a continuously repeated scan sequence. However, only a single selected channel is monitored during each sequence. CONTINUOUS . Initiates a continuously repeated scan sequence. All channels are measured sequentially. REMOTE ..... Operates in conjunction with any one of the output options series (-12, -13, or -14) to provide remote start of the scan sequence.

2-16. Printer Paper Installation

2-17. Standard 2¼-inch fan-fold adding machine tape is used as a recording medium for the printer. A package of fan-fold paper is shipped with the 2240A and should be installed before attempting to operate the unit. Use the following procedure for installing the printer paper:

NOTE

The printer is not designed to accommodate rolled paper tape.

a. Fully extend the tape drawer, raise the panel above the drawer to a horizontal position and pull the paper cutter bar away from the printer drum.

b. Pick up the paper pack so that the red marking (visible on one side of the package), is located on the bottom of the stack (some packs may not have the red markings).

c. Remove the band from the paper and fold-out the top sheet. This provides a leader for loading the tape into the printer mechanism.

d. Hold the pack with the leader on top and from the printer. Then slide the pack deep into the tape drawer. When properly positioned, the front of the pack should be just behind the front panel.

e. Turn the printer on using the procedure given in paragraph 2-56.

f. Locate the arrow on the front of the printer mechanism. The arrow points to the paper-feed slot. Hold the paper leader in a horizontal position and insert it as far as possible into the feed slot (≈5/8 of an inch). Depress and hold the PAPER ADVANCE switch until 8 to 10 inches of leader have been fed through the printer mechanism.

g. Thread the leader through the paper-cutter bar and press the bar back into position.

h. Thread the leader through the front panel opening and close the panel. Check to ensure that the paper is still free to advance.

i. The tape drawer should be left in the extended position, and used to store the printed tape

expelled from the printer. Guide the first two or three folds into position in the drawer.

NOTE

Simplified paper loading instructions are given on a decal located in the bottom of the paper drawer.

2-18. Printer Ribbon Installation

2-19. A printer ribbon is supplied with the 2240A and should be installed before attempting to operate the instrument. The ribbon installation location is accessible by raising the printer's front panel to the horizontal position. If the ribbon is already installed, refer to Figure 2-3 and check to ensure that the ribbon is properly positioned on the feed guides and that the ribbon spools are threaded in the proper direction. Use the following procedure for ribbon installation:

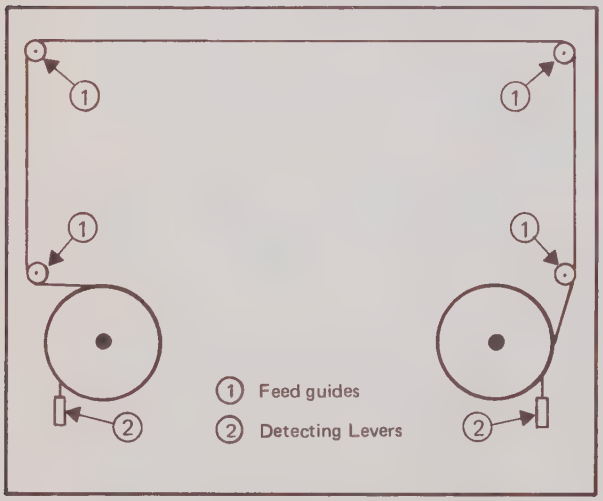


Figure 2-3. Properly Installed Ribbon

a. Separate the ribbon spools and lay them on a flat surface with their finger-side down.

b. Refer to Figure 2-4 and ensure that the ribbon is properly threaded on the spools.

c. On the printer mechanism, locate the push down the detecting lever of either spool shaft (see Figure 2-3) and with the finger side of either spool pointer toward the printer mechanism, slide one of the spools onto the shaft.

d. Unwind 6 or 8 inches of ribbon from the remaining spool, if necessary, and position the ribbon over the feed guides as shown in Figure 2-3.

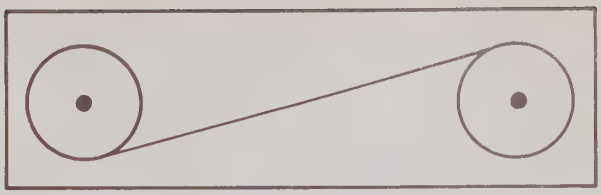


Figure 2-4. Threading Direction for Ribbon Spools

e. Depress the detecting lever on the empty spool shaft and slip the second spool onto the shaft. Make sure there are no twists in the ribbon.

2-20. Option Information

2-21. The front panel operating instructions given in this section of the manual assume that the 2240A contains a full complement of options as shown in Figure 2-5. However, information which is unique to a particular option, such as, description, installation, interface information, maintenance, etc. is contained in the appropriate sub-section of Section 6, Option and Accessory Information.

2-22. Scanner Extension

2-23. The channel scanning capacity of the 2240A can be extended from 60 possible channels up to 1000 channels. The extension is accomplished through the use of one or more of the Model 2201A/2202A/2203A Scanner Chassis which are available as accessories. The units interconnect in a daisy-chain fashion, and the first unit in the chain connects to a rear-panel connector on the A/D Converter pcb (see location B in Figure 2-5).

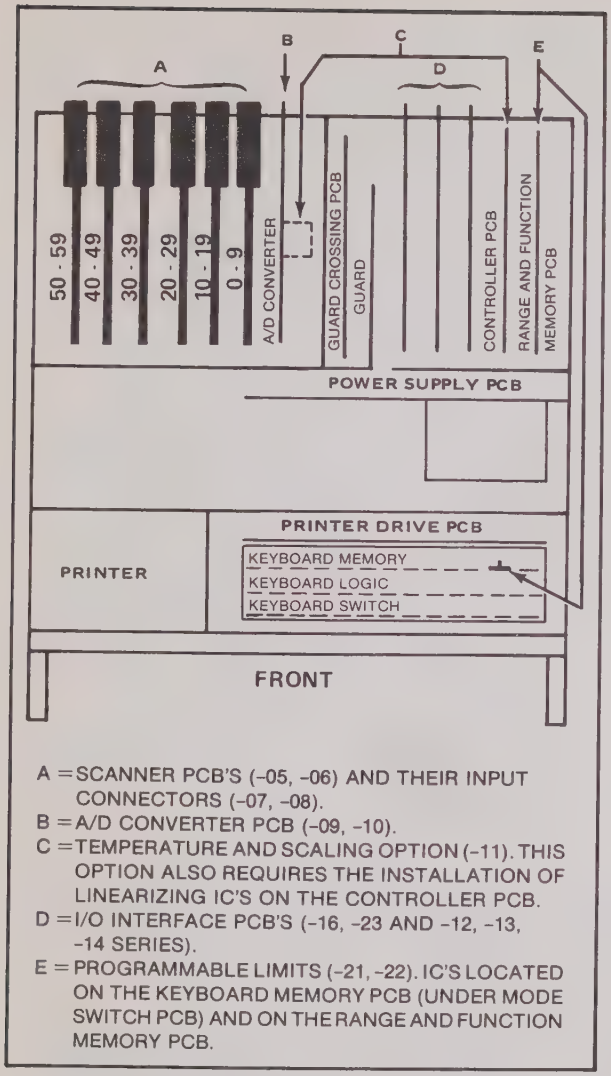
2-24. Each scanner chassis is capable of housing and controlling either 10 (2202A or 2203A) or 12 (2201A) scanner blocks. Since each block contains 10 channels, a total of 100/120 channels can be added with each scanner chassis included in the daisy chain. The 2201A, 2202A and 2203A Scanner Chassis are documented in separate stand-alone instruction manuals.

2-25. Internal Switch Settings

2-26. Several control and function enable switches are contained on the interior of the 2240A. These switches are not intended for use by the operator, and are mentioned at this time for identification purposes only. Each of the switches is named and its location defined in Table 2-2. Instruction for properly setting each switch are also referenced.

2-27. Program Memory

2-28. The 2240A is equipped with a non-volatile memory which is impervious to power interruptions



A = SCANNER PCB'S (-05, -06) AND THEIR INPUT CONNECTORS (-07, -08).
B = A/D CONVERTER PCB (-09, -10).
C = TEMPERATURE AND SCALING OPTION (-11). THIS OPTION ALSO REQUIRES THE INSTALLATION OF LINEARIZING IC'S ON THE CONTROLLER PCB.
D = I/O INTERFACE PCB'S (-16, -23 AND -12, -13, -14 SERIES).
E = PROGRAMMABLE LIMITS (-21, -22). IC'S LOCATED ON THE KEYBOARD MEMORY PCB (UNDER MODE SWITCH PCB) AND ON THE RANGE AND FUNCTION MEMORY PCB.

Figure 2-5. 2240A Option Installation Locations

caused by either power failures or switching the instrument to power off. The memory is maintained under these conditions by a set of lithium batteries which are switched into service when the line operated power supply is shut down. These batteries will maintain the program memory for a minimum of 5 years. Switches are provided on the memory pcb's (see locations E in Figure 2-5) to remove the batteries from service when the pcbs are not installed in the 2240A.

2-29. Individual/Block Mode

2-30. The basic 2240A contains the memory necessary to program up to 128 individual input channels. This capability is increased to 256 individual channels when the Program Memory Expansion Option (—20) is installed. If more than 256 channels are required, the 2240A is operated in the block mode. That is, the first

Table 2-2. Internal Switch Information

SWITCH NAME	LOCATION (See Figure 2-5)	FUNCTION AND POSITION INFORMATION
50/60 Hz	Power Supply PCB	Para. 2-6
115/230V ac	Power Supply PCB	Para. 2-6
°C/°F	Controller PCB #3*	Para. 2-9 (See Option -11)
Block/Individual	Controller PCB #4*	Para. 2-29 (See Option -20)
Battery	Range and Function Memory PCB	Para. 2-27
Battery	Keyboard Memory PCB	Para. 2-27
Fast/Slow	A/D Converter PCB (-10 Only)	See Section 6, Option -10

**Switches 1 and 2 are not used.*

Switch 3 selects the °C (OFF) or °F (ON) scale when Option -11 is installed.

Switch 4 selects the block (OFF) or individual (ON) mode of operation.

170 channels are individually programmed and the last 830 channels are programmed as 83 blocks of 10 channels each. Thus, a total of 1000 channels (170 + 830) can be programmed when Option —20 is installed and the unit is operated in the block mode.

2-31. The individual or block mode of operation is selected by a switch (#4) located on the Controller PCB Assembly on the interior of the 2240A (see Figure 2-5). The individual mode is selected when the switch is in the ON position; OFF selects the block mode.

2-32. Power Failure

2-33. The TIME ENTRY switch group contains a lamp which blinks to indicate the occurrence of a line-power interruption during normal operation of the 2240A. The lamp begins to blink after power is restored and serves as a visual flag to indicate that the displayed date and time is in error. The restoration of line power resets the clock to zero, allowing it to operate as an elapsed time counter. Thus, the clock provides a direct read-out of the time elapsed since power was restored. Instructions for resetting the clock are given later in this section under Operation.

2-34. Output Control

2-35. The OUTPUT CONTROL switch group provides the operator with manual control over the operation of the data recording devices associated with the 2240A. The switches are divided into two separate groups: PRINTER ENABLE and EXTERNAL ENABLE. The PRINTER ENABLE switches apply only to the

operation of the internal printer. The EXTERNAL ENABLE switches affect all external recording devices which are interfaced with the 2240A.

2-36. The function of the switches in both groups, as they apply to their respective recording devices, are identical with the exception of the printer's PAPER ADVANCE (paper feed) switch which is not featured in the EXTERNAL ENABLE group. Therefore, an explanation of the ALL DATA, LIMIT DATA and INTERVAL DATA switches is sufficient to explain the operation of both switch groups.

2-37. The ALL DATA, LIMIT DATA, and INTERVAL DATA switches are of the push-push type and each is capable of independent operation. When all three switches are in the released or out position, the associated recording devices are inhibited from recording output data from the 2240A. Depressing one or more of the switches allows selected data to be recorded. Table 2-3 lists all of the possible switch combinations, the mode(s) in which data will be recorded, and the kind of data recorded.

Table 2-3. Data Recorded for Various Output Control Switch Settings and Scan Modes

DATA RECORDED	APPLICABLE MODES				OUTPUT CONTROL SWITCH SETTINGS		
	MONITOR	SINGLE	INTERVAL	CONTINUOUS	ALL DATA	LIMIT DATA	INTERVAL DATA
NONE	X	X	X	X	○	○	○
INTERVAL	X		X	X	○	○	●
LIMIT	X	X	X	X	○	●	○
INTERVAL AND LIMIT	X		X	X	○	●	●
ALL	X	X	X	X	●	○	○
ALL	X	X	X	X	●	○	●
ALL	X	X	X	X	●	●	○
ALL	X	X	X	X	●	●	●

● = DEPRESSED (IN)
○ = RELEASED (OUT)

NOTE

The program list feature requires that both the ALL DATA switch in the PRINTER ENABLE switch group and the RESET switch in the SCAN CONTROL switch group be depressed prior to pressing the PROGRAM LIST switch.

2-38. Scan Control

2-39. The scan sequence is both started and stopped by the six switches which comprise the SCAN CONTROL group. Five switches (SINGLE, INTERVAL, MONITOR, CONTINUOUS, REMOTE) are provided to initiate separate variation of the scan sequence, and a single STOP/RESET switch is provided to terminate the selected sequence at any point in time. The basic scan sequence is initiated by the SINGLE switch, and is keyed to manually enter program data. A simplified sequence of events in the single scan mode is as follows:

a. The first channel relay in the program sequence closes and connects an external stimulus to the input of the A/D Converter (Option —09 or —10).

b. The A/D Converter measures the input signal in terms of the programmed function (volts, millivolts or temperature) and provides a digital display of the results.

c. The displayed value is compared against a programmed high and/or low limit value (Option —21 or —22).

d. If a recording device has been enabled, the channel, measurement, and function data are recorded. Also, prior to each scan sequence, the time-of-year and the fixed heading data are recorded.

e. The first channel relay is opened and the second channel relay in the sequence closed to connect its external input to the A/D Converter.

NOTE

Channels between the first and last channels can be skipped under program control. Therefore, the measurement channels may be separated by several skipped channels. For example, the channel sequence might appear as follows: 1, 2, 8, 14, 15, 20. Where, channel 1 is the first channel and 20 is the last channel.

f. Steps b, c, and d are repeated.

g. The channel relay is opened and the next programmed channel relay is closed. Its input is measured, compared and recorded.

h. Step g is repeated for each programmed channel until the last channel has been scanned.

2-40. Variations of the single scan mode include: interval and continuous. The interval scan mode causes the single scan sequence to be repeated at a programmed time interval. The time interval is the time between the start of one sequence and the start of the next sequence. Interval time can be programmed from a minimum of 1 second to a maximum of 23 hours, 59 minutes and 59 seconds (23:59:59). A 1-second resolution can be achieved for any interval time within the 24-hour limit. The continuous mode causes the scan sequence to be continuously repeated with a minimum time between the end of one sequence and the start of the next sequence (typically ⩽ second). The monitor scan mode allows the operator to monitor a single selected channel during a scan sequence. The monitored channel is addressed in conjunction with the MONITOR CHANNEL switch in the SCAN FORMAT group and the DATA ENTRY keyboard. Pressing the ADVANCE ADDRESS switch incrementally advances the monitor address and allows the operator to manually scan and measure the input present at each of the accessible channels. The monitor mode is useful for both program verification and troubleshooting.

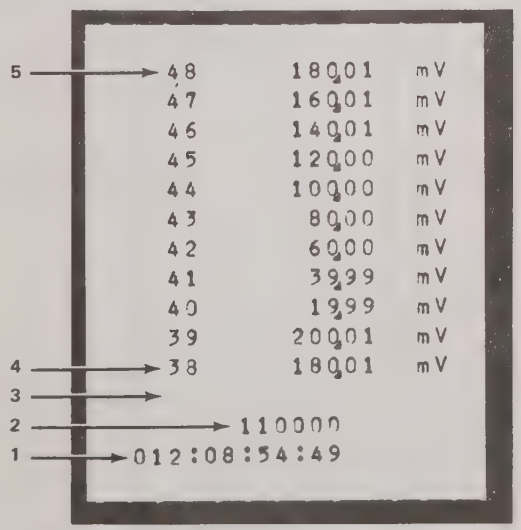
2-41. The remote mode is operational only when an output option (—12, —13, —14 series) is installed in the 2240A. Depressing the REMOTE switch enables the remote start of a scan sequence. Refer to Section 6, Option and Accessory Information, for details concerning the remote start capabilities of the output options.

2-42. Display Control

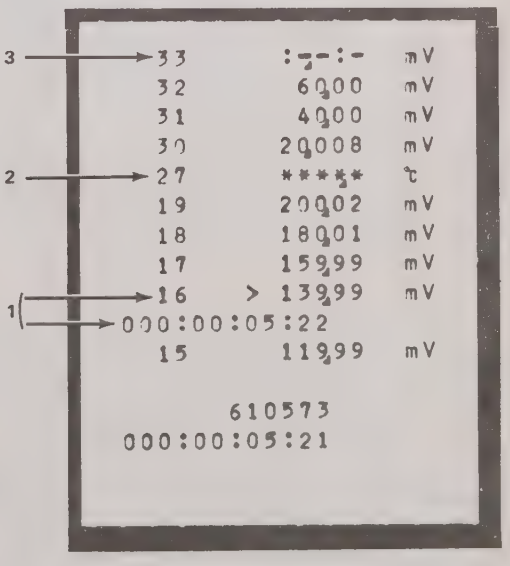
2-43. The DISPLAY CONTROL switch group contains three switches which allow the operator to manually assign the display to read one-of-three types of data (All Channels, Monitor Channel or Date and Time) without initiating a programming or scan-control sequence. For example, assume that a continuous scan sequence is in progress and the operator initiates and/or executes a change in the scan format. The operator can exit the programming mode at any time and assign the display to read either all channel measurements, monitor channel measurements, or date and time by pressing the appropriate switch in the DISPLAY CONTROL switch group. Reassigning the display in this manner allows the operator to enter or verify program data without interrrupting the scan sequence.

2-44. Print/Record Format

2-45. Measurement data generated during a scan sequence can be recorded on the printer and/or any external recording devices interfaced with the 2240A. Examples of the recording format for any given scan sequence is shown in Figure 2-6. The example assumes the printer as the recording device.



1. DATE AND TIME
2. FIXED DATA - 2240A or SCAN COUNTER - 2200A
3. DIGITAL INPUT (—16 Option)
4. DATA FIRST CHANNEL
5. DATA LAST CHANNEL



1. LIMIT EXCEEDED
2. OPEN THERMOCOUPLE
3. OVERLOAD

Figure 2-6. Typical Format of Printed Measurement Data

2-46. Fixed Data

2-47. Fixed data is a six-digital number which is recorded after the date and time. The number is manually entered by the operator to identify the program, lot, run, project, etc., associated with the scan sequence and can be any number from 000000 to 999999. Once entered, the number will remain fixed until a new one is entered.

2-48. Improper Program Data

2-49. An IMPROPER ENTRY lamp is provided in the DATA ENTRY switch group to indicate that an attempt to enter illegal program data has been made. An operator error in format or data entry causes the lamp and the displayed data to begin flashing. As long as the lamp is flashing, the STEP/ENTER switch is inhibited to prevent the improper data from being entered into memory. The improper entry condition can be cleared by pressing the CLEAR ENTRY switch, or by entering new data. (When the keyboard program senses an error, it prepares itself to accept new data without the aid of the CLEAR ENTRY switch. CLEAR ENTRY is used primarily for correcting (erasing) partial entries and starting again.)

2-50. Programmable Limits

2-51. Programmable measurement limits (Option –21 or –22) are available as a block of up to 30 separate and variable values, each of which is addressable for use by all available channels. The limits are split into two equal groups, (1 to 15 (LIMIT A)) and (16 to 30 (LIMIT B)), and one limit from either or both groups can be assigned to a given channel. However, two limits from the same group cannot be assigned to the same channel. Therefore, when a channel measurement requires two limits (high and low), each must be taken from a separate limit group.

2-52. The actual value of a limit word can range from a minimum of —39990 to a maximum of 39990. The least-significant digit is not programmable and is always zero. Since the programmed limit value is to be compared directly against the measurement reading, care must be taken to ensure that the limit's magnitude is compatible with the selected function and range and visa-versa. For example, a limit value of 10000 can represent a limit of 10.000V, 1.0000V, 100.00 mV, 10.000 mV, 1000.0°F or 1000.0°C depending upon the selected function.

2-53. When a limit is exceeded during a scan sequence, a LIMIT EXCEEDED lamp in the PROGRAMMING switch group begins to blink, and continues to blink until it is reset. The reset is accomplished by pressing the adjacent RESET switch. Recorded limit data is also identified as greater than (>) or less than (<) the specified limit. In addition, the printer records out-of-limits data in red for easy identification. The date and time is also printed prior to each out-of-limits measurement.

2-54. Program List

2-55. The 2240A is equipped with a program-list feature which allows the operator to solicit and record the contents of the program memory. The listed information includes date and time; time interval; fixed data; monitor channel; all available limit addresses (30 maximum) and their respective sense, polarity and value; and channel programming for each channel from first to last. Channel programming includes function and limit data assigned to each channel. A sample of the program list format is given in Figure 2-7.

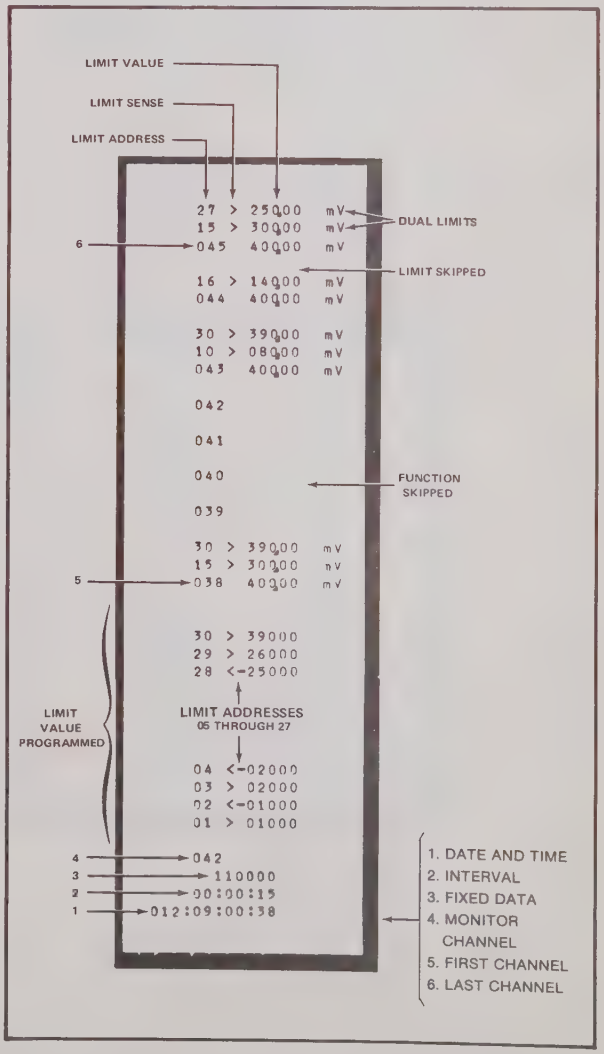


Figure 2-7. Typical Format of Program List Data

2-56. The program list feature should be employed both before and after entering new program data. By listing the old program, the user will know what must be added to or deleted from memory during the reprogramming process. Listing a newly entered program allows the operator to verify its accuracy.

NOTE

The program list feature requires that both the ALL DATA switch in the PRINTER ENABLE group and the RESET switch in the SCAN CONTROL switch group be depressed prior to pressing the PROGRAM LIST switch.

2-57. Audio-Tone Keyboard

2-58. As a programming aid, the 2240A includes the capability of rejecting the entry of both invalid and improperly formatted program data. The entry of each valid data character is accompanied by an audio tone when one of the keyboard switches is depressed. The tone indicates that the data is valid and has been accepted by the 2240A. The absence of the audio tone indicates that the data is either invalid or improperly formatted and has not been accepted by the 2240A.

2-59. OPERATION

2-60. Turn-On Procedure

2-61. Use of the following procedure is suggested for initial turn-on of the 2240A. With reference to the previous paragraphs turn on the 2240A as follows:

a. Connect the 2240A to line power (see paragraph 2-6).

b. Install available options, as required.

c. Connect interface cables, as required.

d. Press the STOP/RESET switch in the SCAN CONTROL group.

e. Insert the key in the Power switch and set it to POWER ON. The display should illuminate and read 22401 for approximately 3 seconds. After the 3 seconds, the display will indicate elapsed time starting at 000 00:00:03 (3 seconds).

f. Press the ALL DATA switch in the PRINTER ENABLE group.

g. Press the PROGRAM LIST switch. The program currently in memory will be printed.

2-62. Turn-Off Procedure

2-63. The Turn-Off Procedure consists of a single step: Insert the key into the Power switch and set it to POWER OFF.

NOTE

The turn-off procedure will not clear or alter the program data present in the 2240A.

2-64. Entering Program Data

2-65. Meaningful operation of the 2240A requires the manual entry of a series of program words to define the variable associated with a scan sequence. The procedures required to enter each variable are given in the following paragraphs. Completion of the entire series of procedures, in the order given, is recommended to familiarize the inexperienced operator with the programming requirements of the 2240A. However, it is not necessary for the experienced operator to complete the procedures in the order given. Nor, is it necessary to complete an entire procedure. Thus, variables not affected can be omitted from any of the procedures.

NOTE

Generating a written program prior to entry simplifies the programming process, and ensures duplication when re-entering old programs. A recommended format for a program form is given in Figure 2-8.

2-66. INITIAL PROCEDURE

2-67. Perform the following procedure prior to attempting to program the 2240A:

a. Complete the Turn-On Procedure given earlier in this section.

b. Set the Power switch to POWER ON.

c. Release all switches in the EXTERNAL ENABLE section of the OUTPUT CONTROL group.

NOTE

After the 2240A has been programmed, accidental alteration of the program can be avoided by setting the Power switch to KEYBOARD PROGRAM DISABLE and removing the key from the switch.

2-68. TIME ENTRY

2-69. The date and time must be updated after the Turn-On Procedure is performed, and after a power

VIKING OPERATIONS INC.

FLUKE 2240A PROGRAM FORM

FIRST CHANNEL _____ INTERVAL _____
LAST CHANNEL _____ FIXED DATA _____
MONITOR CHANNEL _____

TEST NO. _____
SH _____ OF _____
DATE _____

CHANNEL PROGRAM

CHANNEL ADDRESS	FUNCTION	ADDRESS LIMIT A (1-15)	ADDRESS LIMIT B (16-30)

interruption has occurred. The POWER FAILURE/RE-ENTER TIME lamp flashes to indicate that the clock is in error. Use the following procedure to update the date and time.

a. If the DAY display indicates the wrong date, press the DAYS switch in the TIME ENTER group. The HRS: MIN: SEC portion of the display will go blank.

b. On the DATA ENTRY keyboard, serially enter the Julian day-of-year or an equivalent three-digit date code. As each digit is entered, it will be presented on the DAY portion of the display. If the entry was made incorrectly, press the CLEAR ENTRY switch on the DATA ENTRY keyboard and then re-enter the proper day.

NOTE

When using the DATA ENTRY keyboard, it is not necessary to enter leading zeros.

c. After the desired day is displayed, enter it into memory by pressing the ENTER/STEP switch on the DATA ENTRY keyboard. The DATA display should now be illuminated.

NOTE

When the HR, MIN, SEC switch is pressed the clock is not actually stopped. It continues to run and can be recalled at any time prior to pressing the ENTER/STEP switch by pressing DATE AND TIME.

d. Press the HR MIN SEC switch in the TIME ENTRY group. The DAY portion of the display should go blank.

e. Serially enter the desired time on the DATA ENTRY keyboard; hours first, seconds last. Remember that the clock is to be restarted at some future time and should be synchronized with the true time-of-day. Therefore, the time entered on the keyboard should agree with the time at which the clock is to be started.

f. Synchronize and start the clock by pressing the ENTER/STEP switch.

2-70. SCAN FORMAT

2-71. The scan format program involves the variables which define the scope of a scan sequence. These include; fixed data, first channel, last channel, time interval, and monitor channel address. Use the following procedure to program the scan format:

a. Press the FIXED DATA switch in the SCAN FORMAT group. The six-digits currently in memory will be presented on the DATA display.

b. If the fixed data is incorrect, serially enter the desired data on the DATA ENTRY keyboard (MSD first) and press the STEP/ENTER switch. If the original data is correct, no action is required.

c. Press the FIRST CHANNEL switch in the SCAN FORMAT group. The first channel address currently in memory will appear on the CHANNEL display.

d. If the channel displayed is incorrect, serially enter the desired first channel on the DATA ENTRY keyboard and press the ENTER/STEP switch. If the original channel is correct, no action is required.

NOTE

If a selected channel is larger than allowed by the loaded options (—21, —22 or —23) the channel display and the improper entry LED will flash when ENTER/STEP is pressed.

e. Press the LAST CHANNEL switch in the SCAN FORMAT group. The last channel currently in memory will appear on the CHANNEL display.

f. If necessary, enter the correct last channel on the DATA ENTRY keyboard and press the ENTER/STEP switch.

g. Press the INTERVAL HR MIN SEC switch in the SCAN FORMAT group. The time interval currently in memory will be displayed in hours, minutes, and seconds on the DATA display.

h. If necessary, enter the desired time interval on the DATA ENTRY keyboard and press the ENTER/STEP switch.

i. Press the MONITOR CHANNEL switch in the SCAN FORMAT group. The current address of the channel to be monitored will appear on the CHANNEL display.

j. If a new monitor channel is desired, enter it on the DATA ENTRY keyboard and press the ENTER/STEP switch.

2-72. LIMITS PROGRAMMING

2-73. The memory required to program measurement limits is available only when the 2240A is equipped with

either one or two of the set-point limits options (—21 or —22). The following procedure assumes that two Fifteen Single-Limit Set Point Options (—22) have been installed in the 2240A. Prior to attempting to program the limits, the operator should familiarize himself with the limit capabilities available in his 2240A. Use the following procedure to assign limit magnitude, polarity, and high or low sense to one or more of the 30 possible limit addresses. To simplify programming, the limits assigned to each address should be determined prior to entering limit address data in the Channel Programming procedure.

NOTE

When two limits are associated with a single measurement, care must be taken to ensure that the limits appear in separate address groups 1 through 15 for group A, and 16 through 30 for group B. High or low sense can be assigned to any address in either group. However, two limits within one group cannot be utilized simultaneously.

a. Press the LIMITS ENABLE switch in the PROGRAMMING switch group. The ENTER ADDRESS lamp will light.

b. Enter the desired limit address (1 through 30) on the DATA ENTRY keyboard and verify its correctness on the CHANNEL display.

NOTE

If a selected channel is larger than allowed by the loaded options (—21, —22 or —23) the channel display and the improper entry LED will flash when ENTER/STEP is pressed.

c. Press the ENTER/STEP switch on the DATA ENTRY keyboard. The ENTER ADDRESS lamp will go out and the ENTER SENSE lamp will light.

d. Enter HI LIMIT or LO LIMIT as desired on the DATA ENTRY keyboard. The ENTER SENSE HI/LO lamp will indicate the selected sense. Press the ENTER/STEP switch. The ENTER SENSE lamp will go out and the ENTER VALUE lamp will light.

e. Enter the numeric value of the addressed limit on the DATA ENTRY keyboard. If the value is to be negative, press the minus (–) key before, during or after the numeric value is entered. Positive values do not require a polarity entry.

NOTE

The number of digits in a limit value should be compatible with the measurement function it is to be compared with. For example, a limit value of 10000 can represent a limit of 10.000V, 1.0000V, 100.00 mV, 10.000 mV, 1000.0° F or 1000.0° C depending upon the selected function.

f. Press the ENTER/STEP switch. The ENTER VALUE lamp will go out and the ENTER ADDRESS lamp will light.

NOTE

Limit values outside the range of ±39990 may not be entered.

g. Progress to the next applicable limit address by either entering it via the DATA ENTRY keyboard and pressing the ENTER/STEP switch, or pressing the ADVANCE ADDRESS switch until the correct address is displayed.

h. Update the limit sense and limit value by repeating steps d, e and f of this procedure.

i. Repeat steps g and h to update any additional limits for use in the scan sequence.

2-74. CHANNEL PROGRAMMING

2-75. Use the following procedure to assign the appropriate measurement function and limits address(es) to each channel included in a scan sequence; i.e., first channel to last channel as defined in the Scan Format program procedure:

a. Press the CHANNEL ENABLE switch in the PROGRAMMING group. The ENTER ADDRESS lamp will light.

NOTE

If a selected channel is larger than allowed by the loaded options (—21, —22 or —23) the channel display and the improper entry LED will flash when ENTER/STEP is pressed.

b. Using the DATA ENTRY keyboard enter the address of the first channel in the scan sequence and press the ENTER/STEP switch. The selected channel and the currently programmed function will be displayed. The ENTER ADDRESS lamp will go out and ENTER FUNCTION will light.

c. On the DATA ENTRY keyboard, press the appropriate voltage/temperature range (or skip) for the displayed channel, and the, press the ENTER/STEP switch. The ENTER FUNCTION lamp will go out and the ENTER ADDRESS LIMIT A lamp will light.

NOTE

All measurement functions are available as options. Therefore, prior to attempting to select a function, determine whether or not it is available in your 2240A. The IMPROPER ENTRY lamp will light when an invalid function is selected. The condition is cleared by pressing the CLEAR ENTRY switch or selecting an available function.

NOTE

When the ENTER ADDRESS LIMIT A lamp lights, the address of the limit value assigned to that channel is shown on the DATA display. If a limit is not currently assigned the display will read s s s for skip.

d. If a limit from address group A (1-15) is required, enter its address on the DATA ENTRY keyboard and press the ENTER/STEP switch. If a limit from address group A is not required, press the SKIP switch adjacent to the ENTER ADDRESS LIMIT A lamp and press the ENTER/STEP switch. In either case the ENTER ADDRESS LIMIT A lamp will go out and the ENTER ADDRESS LIMIT B lamp will light.

e. Either skip or enter a limit address code from address group B (16-30) and press the ENTER/STEP switch. The ENTER ADDRESS LIMIT B lamp will go out and the ENTER ADDRESS lamp will light.

f. Press the ADVANCE ADDRESS switch. The CHANNEL display will advance to the next channel in the sequence and the ENTER FUNCTION lamp will light.

g. With reference to the following notes, repeat steps c through f of this procedure for each channel in the scan sequence.

1. Any combination of channels between the first and last channels can be skipped by sequentially pressing the SKIP and ENTER/STEP switches when the ENTER FUNCTION lamp is lit. When a channel is skipped, the limit address will be ignored.

2. When a series of channels require identical function and limit data, program the first channel in the series using the above procedure. Then alternately press the ADVANCE ADDRESS and the REPEAT switches for each like channel.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a Block Diagram Analysis of the Model 2240A Data Logger. Both descriptions are supported by simplified block diagrams. Detailed schematics of the individual pcb assemblies are given in Section 8 of this manual.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. The 2240A, as shown in Figure 3-1, is a data processor and recorder which is expandable, through the use of optional plug in modules, into a user designed data acquisition system capable of servicing up to 1000 channels of guarded analog data. Logically, the 2240A can be divided into two major sections, analog and digital. The analog section comprises the Scanner PCB's and the A/D Converter. The remaining blocks comprise the digital section.

3-5. The analog section of the 2240A is an electrically isolated scanner and a/d converter which is used to interface the individual channels of analog data with the control logic contained in the digital section. Analog data is presented to the analog section through a series of plug-in relay scanner pcb's (up to 100 ten-channel scanner pcb's can be serviced). The individual channels are energized under digital control, and the selected channel data is measured and digitized by a dual-slope a/d converter (the analog portion of which is contained on the A/D Converter PCB while the digital portion is contained on the Guard Crossing PCB). After each channel measurement is completed, the Guard Crossing PCB transfers the digitized measurement data across an optical isolator to the digital section. All additional processing of measurement data (e.g., display, recording and comparison) is accomplished by the digital section.

3-6. The digital section of the 2240A is a bus oriented system based upon a four-bit-parallel microprocessor (which is an integral part of the Controller). Three buses are used to route data within the digital section. Two are unidirectional control buses, and the third is a bidirectional data bus (which is used to exchange data between the microprocessor and the other elements of the digital section).

3-7. The control buses (four lines each) are identified as Control Bus A and Control Bus B, and are mutually exclusive in operation. Both control buses are used by the Controller to transmit address data to the various elements (peripherals) of the digital section. When a particular peripheral is addressed, communications between it and the Controller are possible via the bidirectional Data Bus. The address codes and assignments for both Control Bus A and Control Bus B are given in Table 3-1.

3-8. Each address code, in addition to addressing a particular peripheral, also defines the communication function the peripheral is to perform (i.e., transmit or receive). Therefore, peripherals which are capable of both transmitting and receiving data are assigned multiple address codes. Other peripherals, such as the Display, are only capable of receiving data, and therefore, require only one address code. Similarly, the Mode switches are assigned a single address code because they are only capable of transmitting data.

3-9. When an address code is placed on either of the control buses (A or B), the corresponding peripheral is enabled to perform the solicited function; transmit or receive. If a transmit function is enabled, (e.g., the Mode switches are addressed to transmit data on the Data Bus when a binary coded 8 (1000) is placed on Control Bus A), the responding peripheral immediately places its first 4-bit character onto the Data Bus. When the Controller

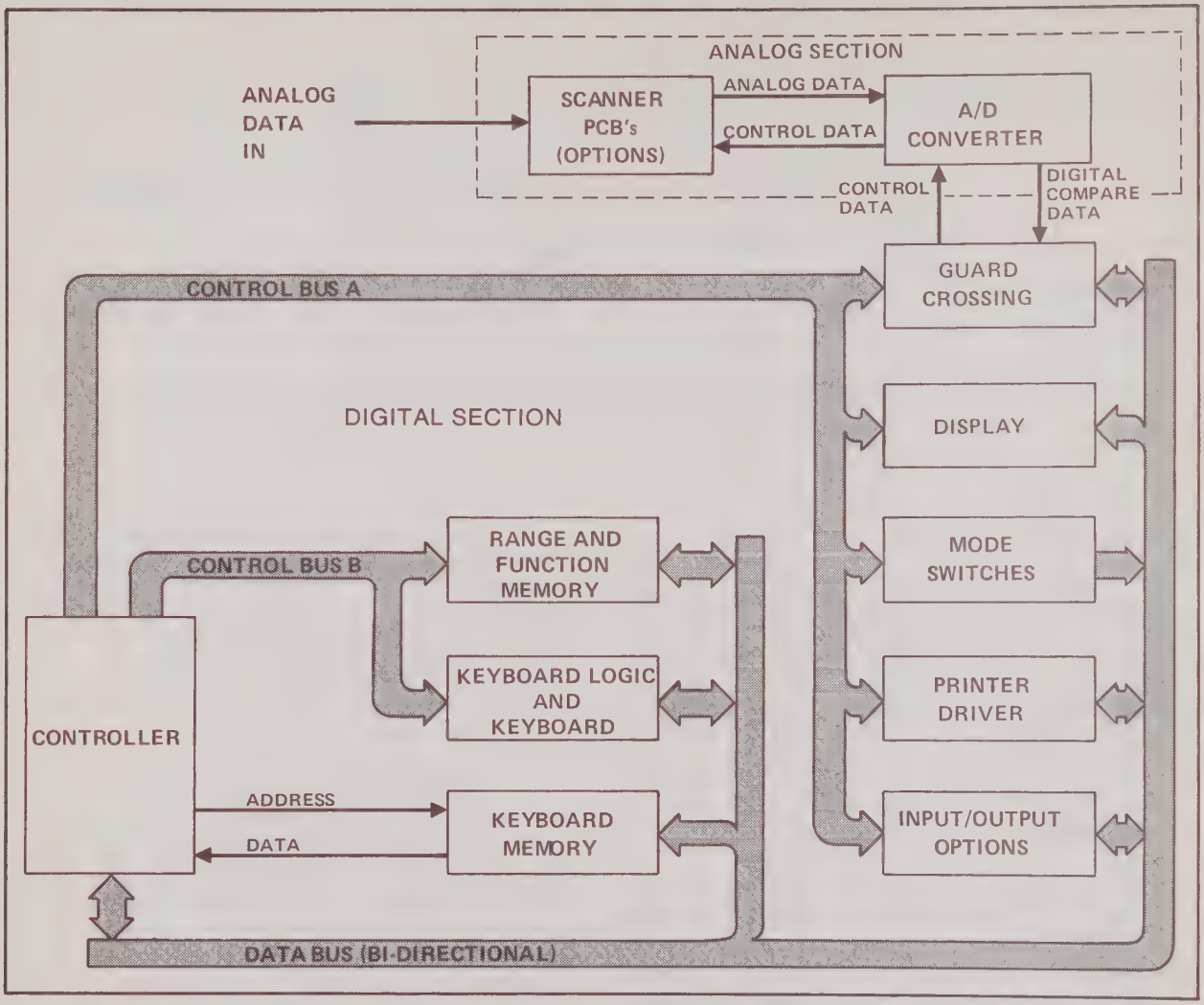


Figure 3-1. 2240A Data Logger, Simplified Block Diagram

Table 3-1. Control Bus Address Codes

CONTROL BUS A		CONTROL BUS B	
CODE* 3 2 1 0	ASSIGNMENT	CODE* 3 2 1 0	ASSIGNMENT
0 0 0 0	Null Character	0 0 0 0	Null Character
0 0 0 1	Guard Crossing Transmit	0 0 0 1	R&F Transmit (Memory)
0 0 1 0	Guard Crossing Receive	0 0 1 0	Limit A Transmit (Memory)
0 0 1 1	Guard Crossing Status	0 0 1 1	Limit B Transmit (Memory)
0 1 1 0	Remote/Output Status	0 1 0 0	Channel Address Receive
0 1 0 1	Printer Receive	0 1 0 1	R&F Receive (Memory)
0 1 0 0	Output Receive	0 1 1 0	Limit A Receive (Memory)
0 1 1 1	Input Transmit	0 1 1 1	Limit B Receive (Memory)
1 0 0 0	Mode Switch Transmit	1 0 0 0	Keyboard Receive
1 0 0 1	Display Receive	1 0 0 1	Keyboard Transmit
1 0 1 0	Not Used	1 0 1 0	Keyboard Status
1 0 1 1	Not Used	1 0 1 1	Not Used
1 1 0 0	Configuration Transmit	1 1 0 0	Alarm Output Receive
1 1 0 1	Printer/Interval Status	1 1 0 1	Not Used
1 1 1 0	Not Used	1 1 1 0	Not Used
1 1 1 1	Not Used	1 1 1 1	Not Used

**Each control bus contains 4 lines. Control Bus A = CA0 through CA3. Control Bus B = CB0 through CB3.*

reads the Data Bus it generates an In strobe. This strobe is used by the addressed peripheral to move the next character for transmission onto the Data Bus. The process is repeated until all of the characters (determined by the Controller) have been transmitted. At that time the Controller removes the address code from the Control Bus and replaces it with a Null-Character Code, 0000. If the receiver function is enabled, the process is similar. However, data moves from the Controller to the addressed peripheral, and an Out strobe is generated to allow the peripheral to receive each data character.

3-10. Three of the peripherals perform functions which are not normally synchronized by the Controller. They are the Power Supply, the Printer and the Guard Crossing. The Power Supply generates a 1 Hz clock pulse to maintain the time-of-year clock, the Printer records data supplied via the data bus and the Guard Crossing sends a/d measurement data to the Controller via the Data Bus. Since the operation of these peripherals is not synchronized with the Controller, each is provided with and interrupt line (IRQ) to notify the Controller that they are ready to perform their function. When any one of the units pull the IRQ line, the Controller responds by interrupting its normal data processing routine and sequentially requesting the status of each of the three peripherals; Guard Crossing, Printer and Power Supply, respectively. The interrupting unit is identified by its status code and serviced as necessary. When multiple interrupts occur, priority is established by the status interrogation sequence. (The interrupt circuit for the Power Supply's 1 Hz output is actually contained on the Controller PCB.)

3-11. BLOCK DIAGRAM DESCRIPTION

3-12. Introduction

3-13. A block diagram description of the 2240A is given in the following paragraphs. The description is keyed to the detailed block diagram shown in Figure 3-2. Each block or group of blocks represents a pcb assembly which is supported by a detailed schematic in Section 8 of this manual.

3-14. Controller PCB Assembly

3-15. The Controller PCB Assembly contains the microprocessor set and its associated program memory and control circuitry. The microprocessor set consists of CPU (U9), Memory Interface (U10) and three RAM's (U19, U20, U21). ROM's U3, U4, U5, U11 and U12 comprise the program memory. Supporting control circuits include a 2Ø Clock Generator, the Interrupt Circuit and the Configuration switches.

3-16. MICROPROCESSOR SET

3-17. The microprocessor set solicits and responds to program data stored in four separate locations; the Control Program ROM's, the Configuration ROM's, the Temperature ROM and the Keyboard Memory (peripheral). The Control Program ROM's contain the program data that determines the basic characteristics of the 2240A. The Configuration ROM's and the Temperature ROM contain alternate temperature measurement programs that can be enabled under program control. The Keyboard Memory is manually programmed via the front panel keyboard and provides the microprocessor set with the following data: First Channel, Last Channel, Monitor Channel, Interval, Fixed Data, and Limit Data Values for Limit Addresses 1 through 30.

3-18. To access data in one of the four program data locations, the CPU (U9) generates a 12-bit address in the form of 3 serial, 4-bit characters. These characters are presented to the Memory Interface (U10) where they are assembled into a 12-bit parallel address word, and placed on the ROM Address Bus. The address word is then presented in parallel to each of the four program data locations. To ensure a response from only the desired program data location, an additional location-enable line is required. Control data for this line is derived from the CPU address word. RAM U19 and 1-of-10 decoder U15 generate the enable for the Configuration and the Control Program ROM's. The Temperature ROM and the Keyboard Memory are enabled simultaneously via the Memory Interface Program Memory (PM) output. The three enable lines are mutually exclusive in operation.

3-19. Program data from the addressed program-data location is placed on the 8-bit ROM data Output Bus (01 through 08) and read by the Memory Interface. The data is then either returned to the CPU for further processing or placed on the Data Bus for use by the peripheral I/O pcb assemblies.

3-20. Since the Control Program ROM's (U3 and U4) contain the instructions which determine the characteristics of the 2240A, they must be addressed when the unit is initially energized. This is accomplished by forcing U19 to present a binary coded 7 (0111) to the 1-of-10 decoder U15, thereby, enabling the Control Program ROM's to respond to the initial 12-bit address on the ROM Address Bus. Subsequent program data locations are accessed under the direction of the Control Program.

3-21. Control and Response Data to and from the Controller PCB Assembly is routed over the bi-directional Data Bus under the direction of the Control Program ROM's. The appropriate peripheral and their

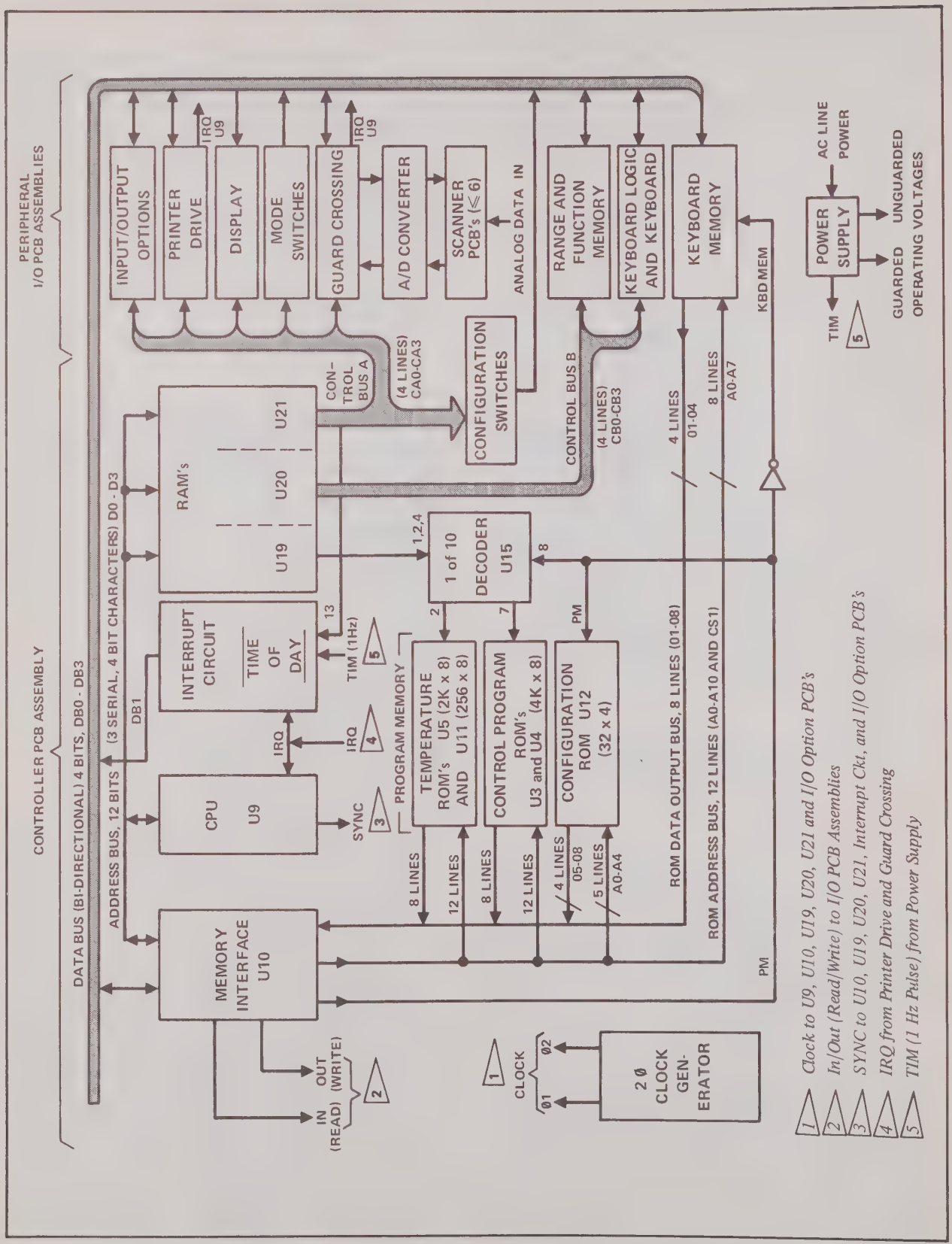


Figure 3-2. 2240A Data Logger, Detailed Block Diagram

desired response (transmit or receive) are solicited by address codes placed on Control Bus A or Control Bus B. These codes are derived from the control program via RAM's U20 and U21. If the addressed peripheral is to return (transmit) data to the Controller PCB assembly, the Memory Interface U10 generates an In strobe to retrieve character-serial data via the Data Bus. If the peripheral is to receive data from the Controller PCB Assembly, the Memory Interface generates an Out strobe after it places each character on the Data Bus. This enables the addressed peripheral to synchronize the serial I/O data with the Controller PCB Assembly.

3-22. TWO PHASE CLOCK GENERATOR

3-23. The microprocessor set is synchronized to a 2Ø, crystal controlled clock. The clock circuitry consists of a synchronous counter U8, a 5.185 MHz crystal Y1, gates U7 and U11, and a level shifter U2.

3-24. In operation crystal Y1 provides the time base (1/5.185 MHz) for a free running oscillator. Counter U8 divides the oscillator output by seven and presents its Q1 (2) and Q2(4) outputs to gates U7B(Ø1) and U7C(Ø2) for decoding. The decoded outputs are then presented to U2 where the 2Ø TTL output signals are shifted to the +5 and -10 volt levels required by the microprocessor set. The timing of the 2Ø clock is shown in Figure 3-3.

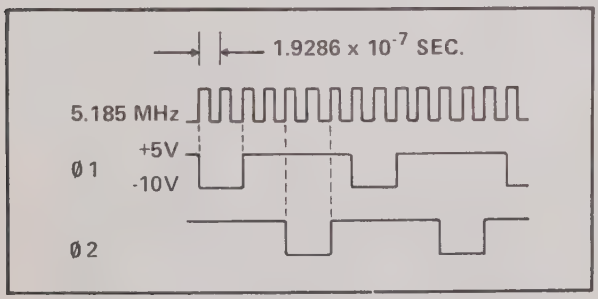


Figure 3-3. Two Phase Clock Timing Diagram

3-25. CONFIGURATION SWITCHES

3-26. The positions of the four Configurations switches, SW1 through SW4, are read by the microprocessor Set when the 2240A is power up. The switches are used as selectable variables which operate in conjunction with the data stored in program memory. Switch SW3 defines the temperature scale, °C or °F, and SW4 selects the individual or block mode of programming. Switches SW1 and SW2 are not used.

3-27. After the 2240A is energized, the Microprocessor Set places a binary coded 12 on Control Bus A. The address is detected by U29 which, in turn, enables the tri-state driver U27. All switch positions are placed on the Data Bus by U27, and read by the CPU when the Memory Interface generates an In strobe. Switch data is assigned to the Data Bus as follows: SW1 to DB3, SW2 to DB2, SW3 to DB1, SW4 to DB0. After the switch data is read, the binary coded 12 address is removed from Control Bus A and the tri-state driver U27 reverts to its normal high impedance output state.

3-28. INTERRUPT CIRCUIT

3-29. The Interrupt Circuit comprises flip-flops U18, gates U13, U24, and U29A, tri-state buffer U27 (E2 half), and transistor Q4. The circuit operates in conjunction with the 1 Hz time interval marker (TIM, from the Power Supply) to update the date and time in the CPU. When a TIM pulse is generated (+5V dc), the next CPU Sync pulse sets flip-flop U18B. Subsequently, the IRQ line is pulled low by transistor Q4. As the CPU interrogates the status of the interrupt peripherals (Guard Crossing, Printer and Power Supply), it places a binary coded 13 on Control Bus A. This address is detected by U29A which, in turn, enables U27. The output of U18A is routed through U27 and a binary coded 2 is placed on the Data Bus (DB1). An In strobe is generated by the microprocessor to read the Data Bus and, thereby, update the current date and time. As the Data Bus is read, the In strobe sets flip-flops U18 and the IRQ line is cleared. The next Sync pulse clocks flip-flop U18 to remove the data from the Data Bus. When the TIM probe returns low, the next Sync pulse clocks flip-flops U18 to the reset state so that the process can be repeated when the next TIM pulse occurs.

3-30. Keyboard Switch and Keyboard Logic PCB Assemblies

3-31. The Keyboard Switch and Keyboard Logic PCB Assemblies, as shown in Figure 3-4, are Controller peripherals designed to function as a unit and to provide the operator-interface necessary to control and program the 2240A. External program data is manually presented to the 2240A through a series of momentary-type switches that comprise a portion of the Keyboard Switch PCB Assembly. When any keyboard switch is pressed, it is detected by the Keyboard Logic PCB and analyzed by the Controller to determine its validity. In response to a valid input, the Controller interrogates the Keyboard Logic, accepts the entered data and returns a series of keyboard instructions to prompt the subsequent action of the operator. These instructions always include an audio tone to indicate the acceptance of entered data, and may include an illuminated prompting LED if a particular programming sequence is required. Additional prompting LED's are used to notify the operator of abnormal operating conditions. They are: POWER FAILURE to indicate the interruption of line power, IMPROPER ENTRY to flag the attempted entry of illegal data or format, and LIMIT EXCEEDED to indicate that a measurement value has exceeded its programmed limit value.

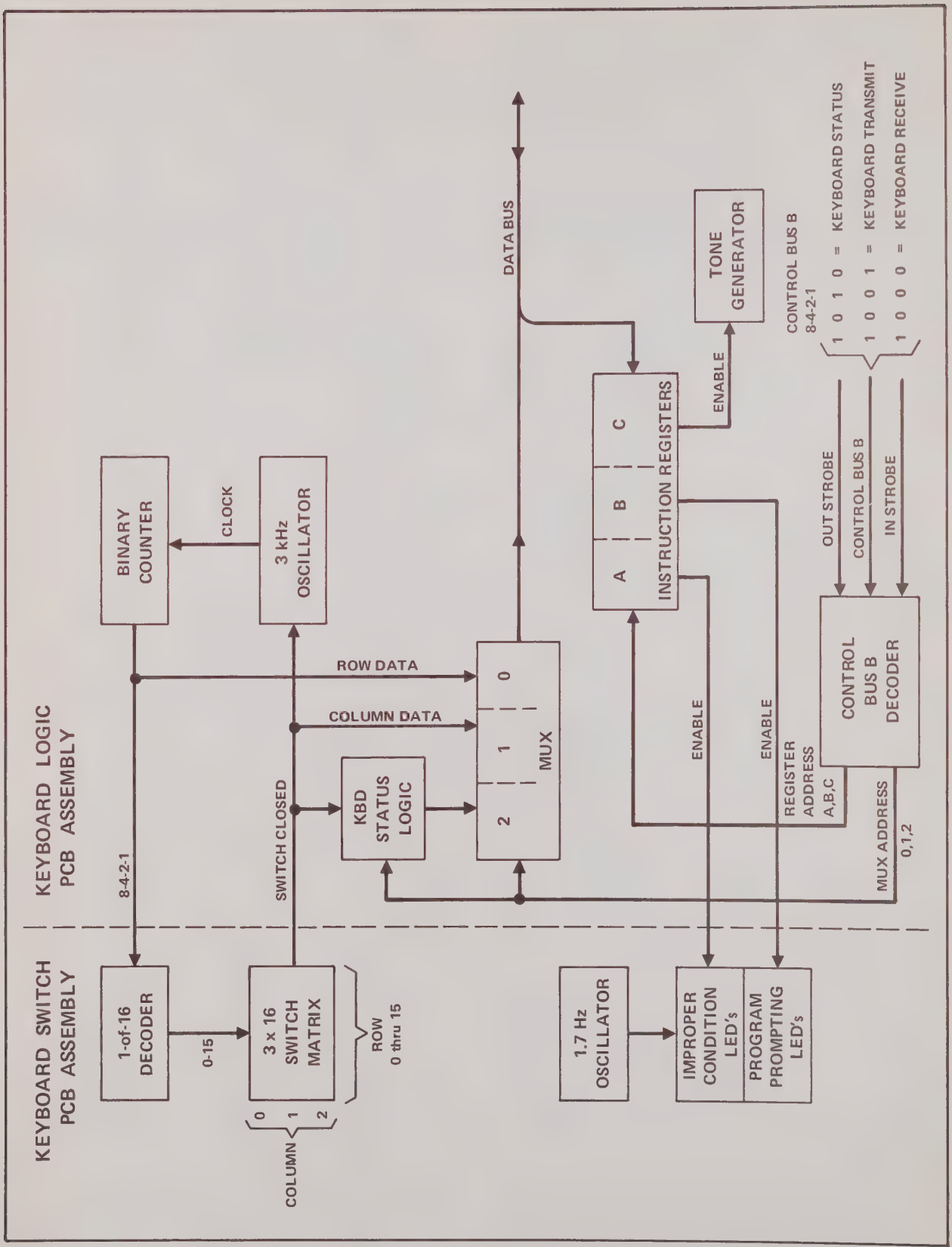


Figure 3-4. Keyboard Switch and Keyboard Logic, Simplified Block Diagram

3-32. Operation begins when power is applied to the circuit. A 3 kHz oscillator free runs to provide a clock input to a four-bit binary counter which, in turn, drives a 1-of-16 decoder. The decoder outputs are connected to the individual rows of a 3-column by 16-row switch matrix. Since the counter continually scans the matrix rows, a switch depression in any row will cause one of the three columns buses to go low. When this occurs, a switch closed signal is generated and the 3 kHz oscillator is stopped. As a result the matrix co-ordinates of the depressed switch are identified. The counter output defines the matrix row and the low column output defines the matrix column. When the matrix switch is released the scanning cycle is resumed.

3-33. Periodically, the Controller interrogates the status of the Keyboard Logic PCB to see if an attempt to enter program data is being made. The interrogation is initiated when the Controller places a binary coded 10 on Control Bus B. A decoder on the Keyboard Logic PCB detects the code and enables channel 2 of a three-channel multiplexer (MUX). Channel 2 data is placed on the Data Bus and returned to the Controller. If the Controller recognizes the following two conditions on the Data Bus (DB0 through DB3) it places a binary coded 9 on Control Bus B as a command for the keyboard to transmit data. If the conditions are not met, the Controller ignores the response and resumes its other activities.

DB0 — A keyboard switch must be depressed.

DB3 — The depressed switch must represent new data (i.e., it has not been read since it was last depressed).

3-34. The receipt of a Keyboard Transmit code (binary 9) causes the Control Bus B Decoder to enable Channel 1 of the three channel multiplexer and, thereby, place the closed-switch, column-coordinate data (Column 0, 1 or 2) onto the Data Bus. An In strobe from the Controller reads the Data Bus and then causes the Control Bus Decoder to enable Channel 0 of the 3 channel multiplexer. Channel 0 places the closed-switch row-coordinate data (0 through 15) onto the Data Bus. The Controller again reads the Data Bus by generating an In strobe, the trailing edge of which is used to remove the keyboard transmit code from Control Bus B and to set a new-data flip-flop in the Keyboard Status Logic. This flip-flop is reset when the depressed switch is released. However, when set, it inhibits the Controller from reading a single switch depression more than once.

3-35. The Controller returns response data to the Keyboard after every accepted keyboard transmission. A series of instruction registers (A, B and C) store the response data and drive the appropriate tone generator or front panel LED's. Response data is presented to the registers via the Data Bus and is loaded into the individual register as a series of 3 four-bit characters. Register A is enabled when the Controller places a Keyboard Receive Code (binary coded 8) on Control Bus B, and is loaded when the Out strobe occurs. On the trailing edge of the Out strobe the Control Bus B Decoder enables Register B and allows it to be loaded on the next Out strobe. Register C is loaded in a similar manner.

3-36. The +5V dc drive for the improper condition LED's is derived from the output of a 1.7 Hz oscillator located on the Keyboard Switch PCB Assembly. When any one of these LED's is activated (via register A) the oscillator causes it to flash.

3-37. Keyboard Memory PCB Assembly

3-38. The Keyboard Memory PCB Assembly is a Controller peripheral designed to function as a non-volitile memory for storing scan format and limit value data entered via the keyboard. This includes: fixed data, first channel, last channel, interval, monitor channel, and (when all-limit options are installed) limit values for limit addresses 1 through 30.

3-39. The simplified block diagram shown in Figure 3-5 identifies the functional logic contained on the Keyboard Memory PCB Assembly, and defines the major flow of data to, from, and within the pcb. Prior to initial turn-on, previously entered program data is stored in a series of RAM's and is maintained by a 5.9V lithium battery. The battery is switched into the circuit during the absence of the Power-On-Reset (POR) signal (high during power-on) as derived from the Power Supply PCB. When power is turned-on, the RAM memory is switched to operate from the unguarded +5V dc (line powered) power supply.

3-40. Memory is enabled for either read or write applications when both the Power-On-Reset signal from the power supply, and the Keyboard Memory (KBD MEM) signal from the Controller are present as Keyboard Memory PCB inputs. These signal are AND'ed to enable a series of tri-state drivers which normally isolate the RAM and prevent it from being read or written into.

3-41. After memory is enabled, read/write operations can be executed in a character-serial fashion. An eight-bit address bus, A0 through A7, is operated by the Controller and used to select a particular location within the RAM's. The upper four bits of this bus, A4 through A7, drive a 1-of-10 decoder to develop the individual IC memory addresses, while the lower four bits, A0 through A3, define the unique character (word) location within the addressed IC. Data present in the addressed memory location is placed onto the Output Bus (O1 through O4) and, if desired, can be read by the Controller. If a word is

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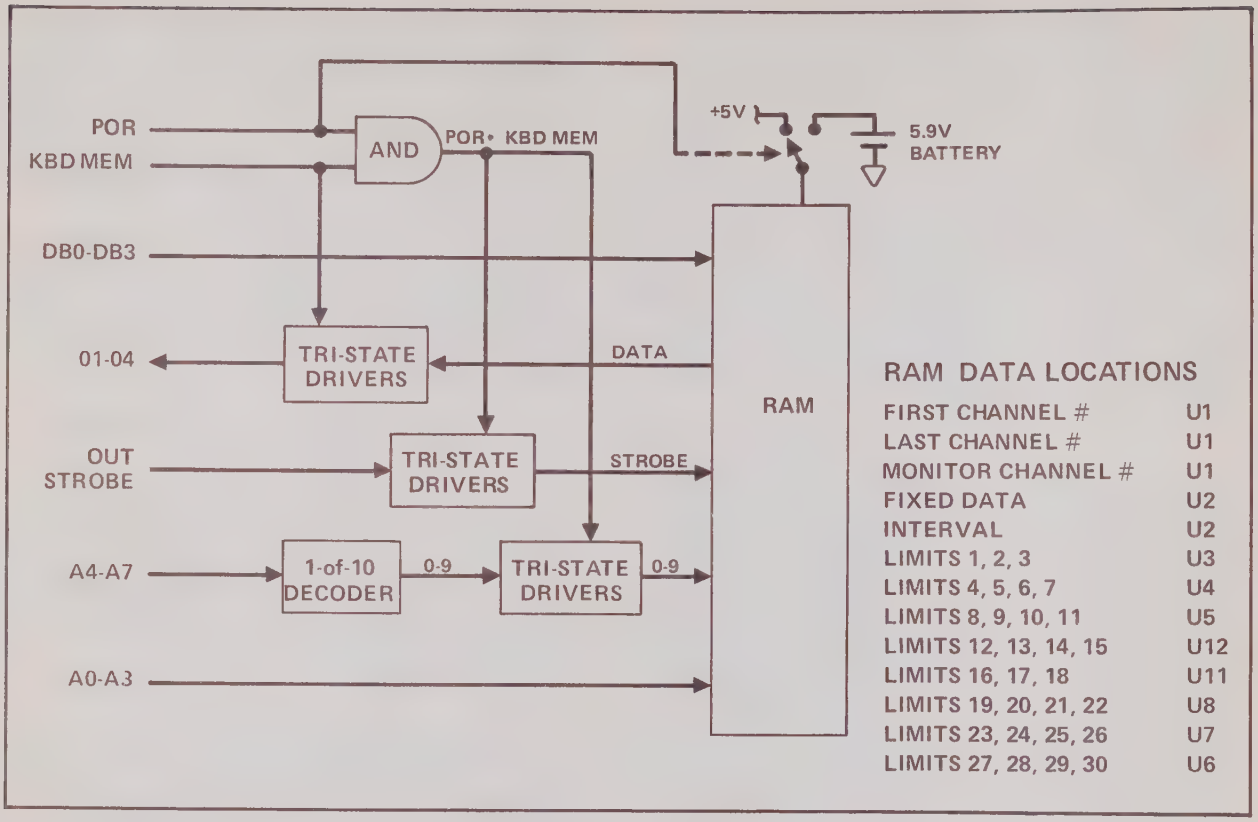

Figure 3-5. Keyboard Memory, Simplified Block Diagram

to be written into the addressed location, the Controller places the new word onto the Data Bus (DB0 through DB3) and then issues a Out strobe.

3-42. Mode Switch PCB Assembly

3-43. The Mode Switch PCB Assembly, as shown in Figure 3-6, operates as a controller peripheral and is capable of both transmitting and receiving data via the Data Bus. In the transmit mode, it provides the Controller with SCAN CONTROL and OUTPUT CONTROL switch-setting information. In the receive mode it accepts and stores numeric decade information from the Controller for use in driving the front panel display. The required operating mode is enabled via address data placed on Control Bus A and is executed under the direction of control signals received from the Controller.

3-44. In the transmit mode of operation the Mode Switch PCB Assembly scans the individual settings of the SCAN CONTROL and OUTPUT CONTROL switches and places the position information (depressed or out) onto the Data Bus for use by the Controller. Transmit mode operation begins when the Controller places a binary coded 8 on Control Bus A. This code is detected by the Control Bus Decoder on the Mode Switch PCB and is used to enable a three-bit Multiplexer Address Control counter. The counter is sequenced by subsequent In strobe pulses from the Controller, and is used to sequentially address each channel of a three channel (four-bit per channel) multiplexer. Each channel of multiplexed data contains the switch position information for 4 of the 12 CONTROL switch settings. This data is presented to the Data Bus on the leading edge of the In strobe, and is assimilated by the Controller on the trailing edge. At the end of the third In strobe all 12 CONTROL switch settings have been transmitted and the Controller removes the address code from Control Bus A. This isolates the Mode Switch PCB from the Data Bus and, thus, the Controller.

3-45. In the receive mode of operation the Mode Switch PCB receives updated display information from the Controller (via the Data Bus) and stores it in a 4 x 16 bit RAM. Receive mode operation begins when the Controller places a binary coded 9 code on Control Bus A. As a direct result of the address code, the RAM address counter is preset to binary coded 11 output (via the RAM control logic) and the front panel display is blanked by a high BI level generated by the display blanking circuit. On the trailing edge of the next Sync pulse the RAM control logic is conditioned to respond to the Controller generated Out strobe. A valid display

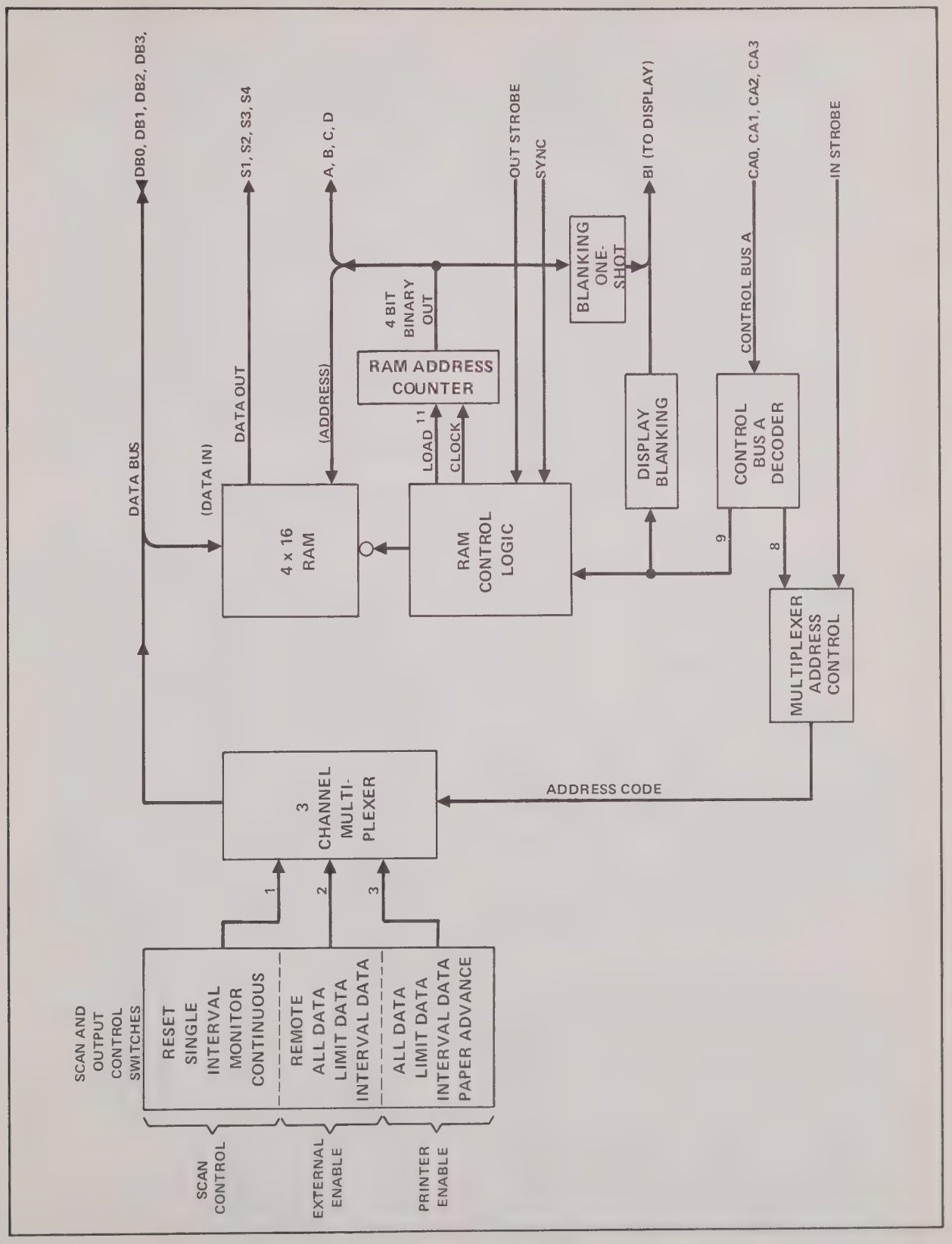

Figure 3-6. Mode Switch, Simplified Block Diagram

character preceeds each Out strobe and is placed on the Data Bus by the Controller. On the leading edge of the first Out strobe the RAM's write enable input is pulled low and the Data Bus character is entered into the binary coded 11 RAM location as defined by the RAM address counter. On the trailing edge of the Out strobe the counter is decremented to 10 and new data is solicited from the Controller. The remaining 11 characters are similarly written into memory by the Controller. After all 12 characters of display data have been written, the Controller terminates the receive mode by removing the binary coded 9 code from Control Bus A.

3-46. When the Mode Switch PCB is not operating in the receive mode the Sync pulse causes the RAM control logic to continuously cycle and, thereby, address the RAM locations. As each location is addressed, its stored four-bit character is presented to the Display PCB via data output lines S1, S2, S3, and S4. Since the RAM does not output data via the Data Bus, transmit and RAM read operation are conducted simultaneously. However, receive and RAM read are mutually exclusive operations.

3-47. A blanking one-shot is used to blank the display if the counter stops running. This prevents the display segments (which are normally scanned) from drawing excessive current in a static situation.

3-48. Display PCB Assembly

3-49. The Display PCB Assembly, as shown in Figure 3-7, operates as an extension of the Mode Switch PCB Assembly. It provides a digital display of either date-and-time, measurement, or program data that has been processed by the Controller, and stored in the 4 x 16 bit RAM on the Mode Switch PCB Assembly. As the RAM locations are serially addressed and read, both the address and the stored data readings are presented to the Display PCB. Address data is received as inputs A, B, C, and D. Stored data is received as inputs S1, S2, S3 and S4.

3-50. The individual display digits are formed by nine 7-segment LED's. These LED's are driven in parallel by the output of a BCD-to-seven segment decoder whose input is taken directly from the Mode switch as S1, S2, S3 and S4. Each of the LED's is individually strobed in serial fashion, and allowed to respond to data present on the seven-line data bus. The strobe sequence is derived directly from the Mode Switch RAM Address counter (A, B, C, D), and each strobed LED is allowed to read the addressed character stored in the (Mode Switch PCB's) corresponding RAM location. Since the data is scanned very rapidly (Sync pulse frequency ÷ 12), the display character appear to be continuously lit.

3-51. In addition to the nine numeric characters, the Data Display PCB also contains provisions for driving the polarity (minus only), annunciator (MILLIVOLTS, VOLTS, TEMPERATURE and DATE AND TIME), and decimal point LED's as stored in the RAM on the Mode Switch PCB. Annunciator data is read from the seven-line data bus as if it were a numeric character. However, polarity and decimal point dta are not. When either of these two RAM locations are addressed (binary coded (or 11) the resultant strobe (from display column decoder) disables the BCD-to-seven segment decoder and enables the decimal point position decoder. Under these conditions the seven-line data bus is dead and data from the addressed RAM location is decoded by the decimal point position decoder. The appropriate decimal point location(s) and/or minus polarity LED's are driven by the output of the decimal point position decoder. Table 3-2 lists each of the display strobe lines decoded from the RAM address counter on the Mode Switch PCB, and indicates the data enabled during each display (strobe) period.

3-52. Printer Drive PCB Assembly

3-53. The Printer Drive PCB Assembly, as shown in Figure 3-8, operates as a Controller peripheral, to interface the internal Seiko Model 102 print head with the Controller Data Bus. Both transmit and receive operating modes are employed in the printing operation. The transmit mode is used to solicit data from the Controller and to synchronize the Controller to the printers mechanical rotation. In the receive mode the Controller sends printer data to the Printer Drive PCB Assembly via the Data Bus. Data for all 16 columns is printed within the time required for one rotation of the printer drum.

Table 3-2. Display LED Addresses and Functions

Strobe Code	LED Enable	LED Function	
11_2	DS5, DS6, DS7, DS8	Decimal Points	
10_2	CR18, CR19, CR20, CR21	Annunciators	
9_2	DS4	Minus Sign	
8_2	DS9	LSD	Data Display
7_2	DS8	5th Digit	
6_2	DS7	4th Digit	
5_2	DS6	3rd Digit	
4_2	DS5	2nd Digit	
3_2	DS4	MSD	
2_2	DS3	LSD	Channel Display
1_2	DS2	2nd Digit	
0_2	DS1	MSD	

3-54. The Printer is a free running device and (to print properly) requires that input data be synchronized with the mechanical rotation of its print drum. Print drum position information is generated by the print head in the form of a Reset pulse and a series of 13

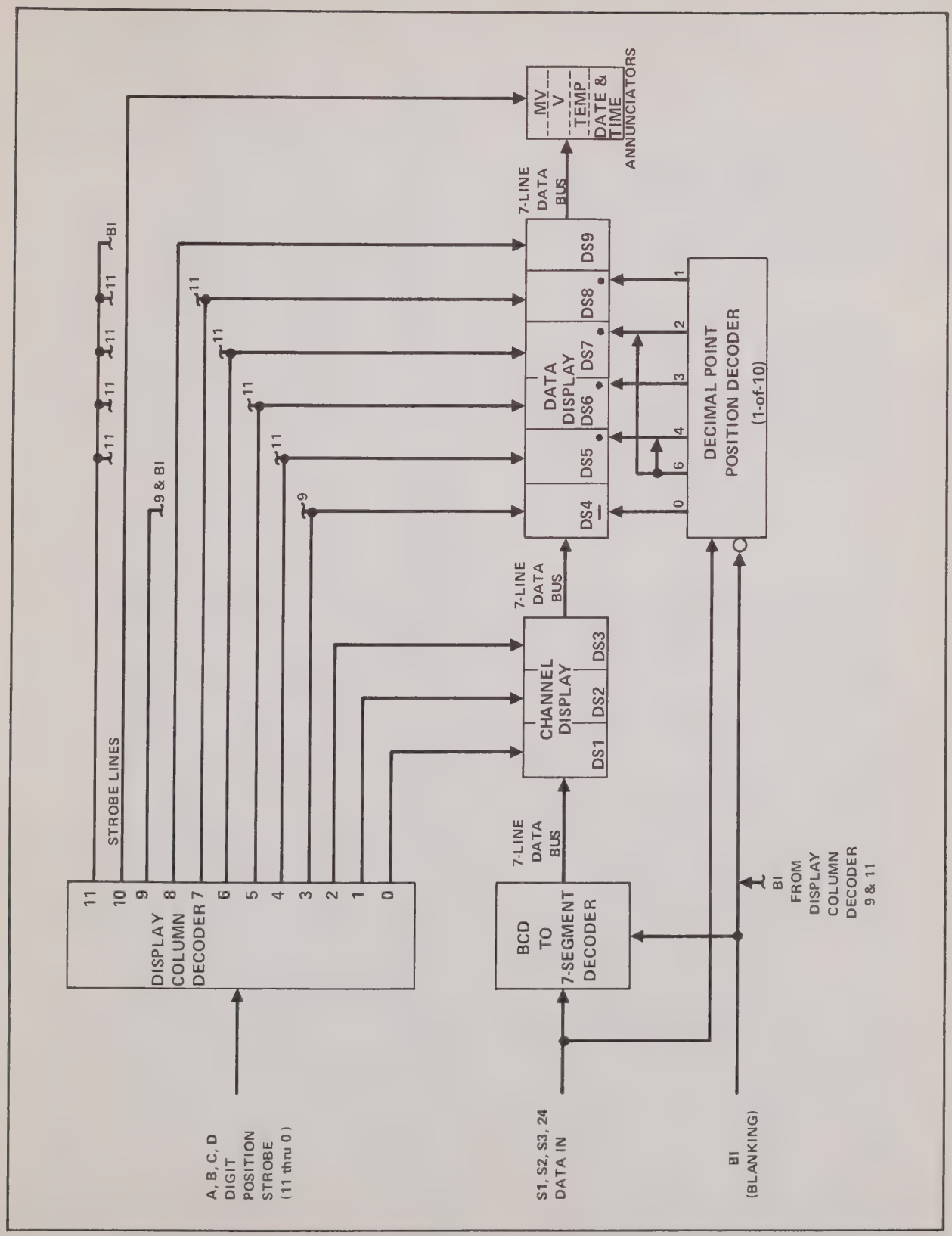

Figure 3-7. Display, Simplified Block Diagram

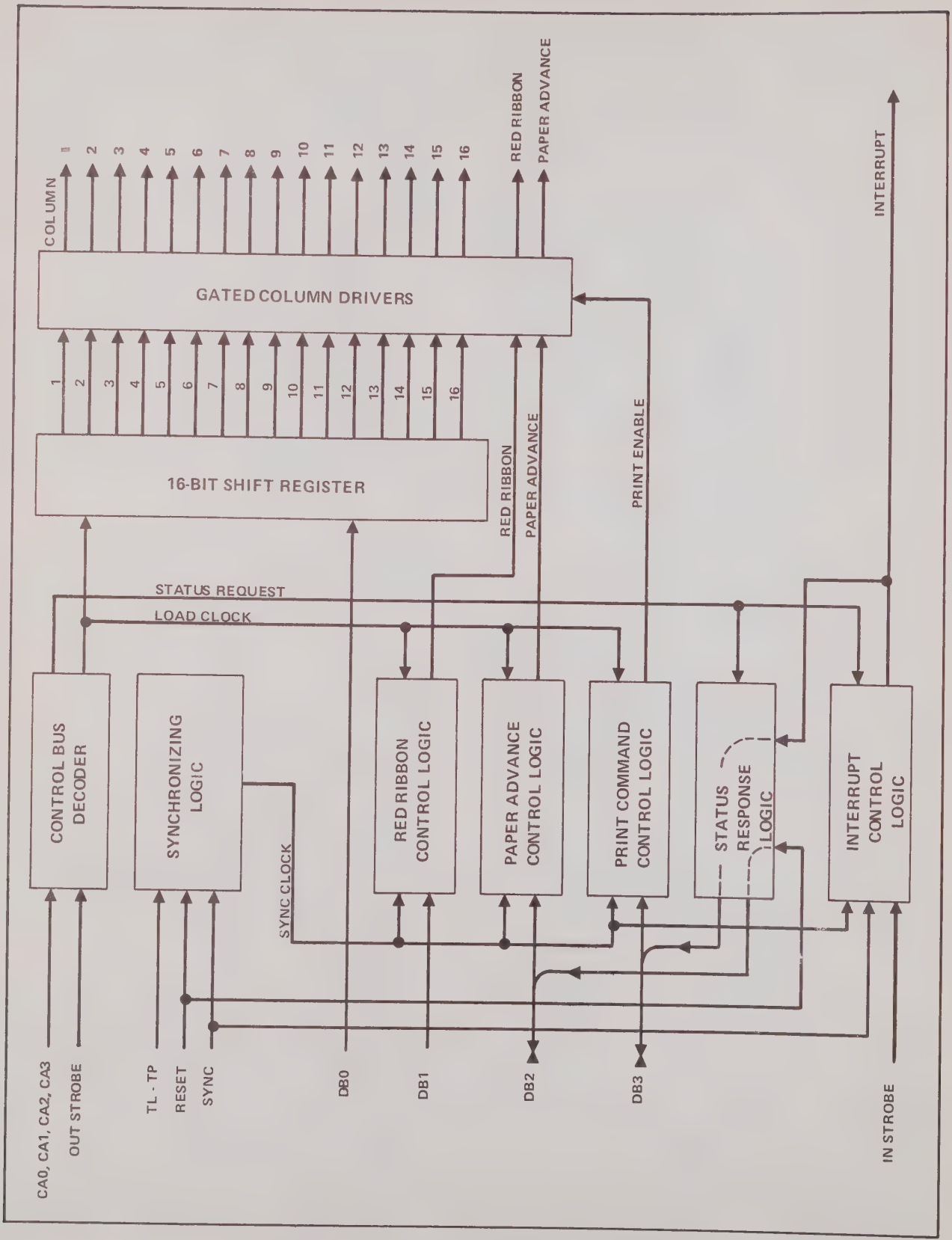

Figure 3-8. Printer Drive, Simplified Block Diagram

TL-TP pulses. Reset is generated once for every print drum revolution and indicates that row 0 is positioned under the 16-column print hammers. TL-TP pulses are generated as each of the 13 possible data rows (0 through 12) are positioned beneath the print hammers. Therefore, for each print drum revolution, 1 Reset pulse is generated and 13 TL-TP pulses are generated.

3-55. The TL-TP pulses from the printer are used by the Printer Drive PCB to synchronize the system clock (Sync) with the printer's drum position. Since the Sync pulse frequency is much higher than the TL-TP frequency, synchronization is accomplished by a coincidence detector and does not require a change in the drum rotation or system clock frequency. When either a Reset or a TL-TP pulse are detected, a pulse is generated by the synchronizing logic. This pulse arms the interrupt control logic to enable the next Sync pulse to generate an Interrupt to the Controller and, thereby, indicate that the printer's drum is in position to receive data.

3-56. In response to the Interrupt, the Controller interrogates the status of the three possible interrupt peripherals to determine which generated the Interrupt signal. When the Printer Drive status is requested (by a binary coded 13 on Control Bus A) it responds by placing the Reset and TL-TP signal levels onto the Data Bus (via status response logic) as bits DB2 and DB3, respectively, thus, confirming that it initiated the Interrupt. When the Controller generates the next In strobe, it reads the confirming interrupt status code (binary coded 12) and then removes the status interrogation code from Control Bus A. As the status request line from the control bus decoder goes low it resets the interrupt control logic and returns the Interrupt to a high level.

3-57. If the Controller is ready to supply data to the Printer Drive PCB when the Interrupt line returns high, it places a binary coded 5 onto Control Bus A. The control bus decoder detects this code and enables the 16 subsequent Out strobes from the Controller to be accepted as a series of 16 Load clocks on the Printer Drive PCB Assembly. As each Load clock is accepted, the bit-serial data on DB0 is loaded into a 16-bit shift register. This stored data determines which print hammers, if any, will be activated while row 0 of the printer drum is under the print hammers. As the 16th data bit is presented to the shift register, Red Ribbon, Paper Advance, and Print Command data are received on DB1, DB2, and DB3, respectively. The subsequent Load clock shifts the last data bit into the 16-bit shift register, enters ribbon color data into the red ribbon control logic, and enters paper advance information into the paper advance control logic. On the trailing edge of the Load clock the print command control logic generates a Print Enable signal. This signal enables the gated column drivers (Tri State drivers) to energize the appropriate print hammers and, thereby, print row 0 characters in the selected columns. The Printer also responds to the red ribbon and paper advance commands, when present.

3-58. As the print drum continues to rotate, row 1 data is loaded into the shift register and the appropriate print hammer are energized. The sequence is performed a total of 13 times (once for each row on the printer drum) to complete a single print sequence. After the 13th Print Enable is derived from the Out strobe, the Controller terminates the sequence by removing the printer receive code (binary coded 5) from Control Bus A.

3-59. Power Supply PCB Assembly

3-60. The Power Supply PCB Assembly, as shown in Figure 3-9, provides the operating voltages for the data logger and a full complement of options. It also provides the 1-second time interval marker (TIM) and the Power-On-Reset (POR) signal. TIM is used by the Controller to update date and time. POR is used to initialize the entire data logger when power is turned on or when a power interruption occurs.

3-61. Input power for the power supply is derived from a 115/230V ac power transformer with four secondary windings. Transformer line-power requirements (115/230V ac) are switch selectable through a switch mounted on the Power Supply PCB. Output windings are separated into two pairs by a transformer shield. Isolation between the pairs is maintained on both the Power Supply PCB and the data logger by including the shield as part of the data loggers guard circuit. As a result the data loggers operating voltages are classified as guarded and unguarded. Guarded voltages include +21 and -21V dc unregulated, and +5V dc regulated. Unguarded supplies include +5V dc, +16V dc, and -10V dc; all of which are regulated and overload protected. The 1-second time base circuitry and the Power-On-Reset circuit are contained in the unguarded section of the power supply.

3-62. Conventional regulating techniques are used in both sections of the power supply. No voltage adjustments are required or included in the guarded section of the supply. In the unguarded section the -10V dc output serves as a reference voltage for both the +5 and +16V dc regulators. As a result, a single adjustment is provided for the -10V dc supply. When the -10V dc is calibrated the +5 and +16V dc supplies are automatically calibrated.

3-63. The 1-second time marker circuit consists of a switch selectable divide-by-50 or divide-by-60 IC whose input clock is derived from the ac voltage present at one of the transformer's secondary windings. When the IC is

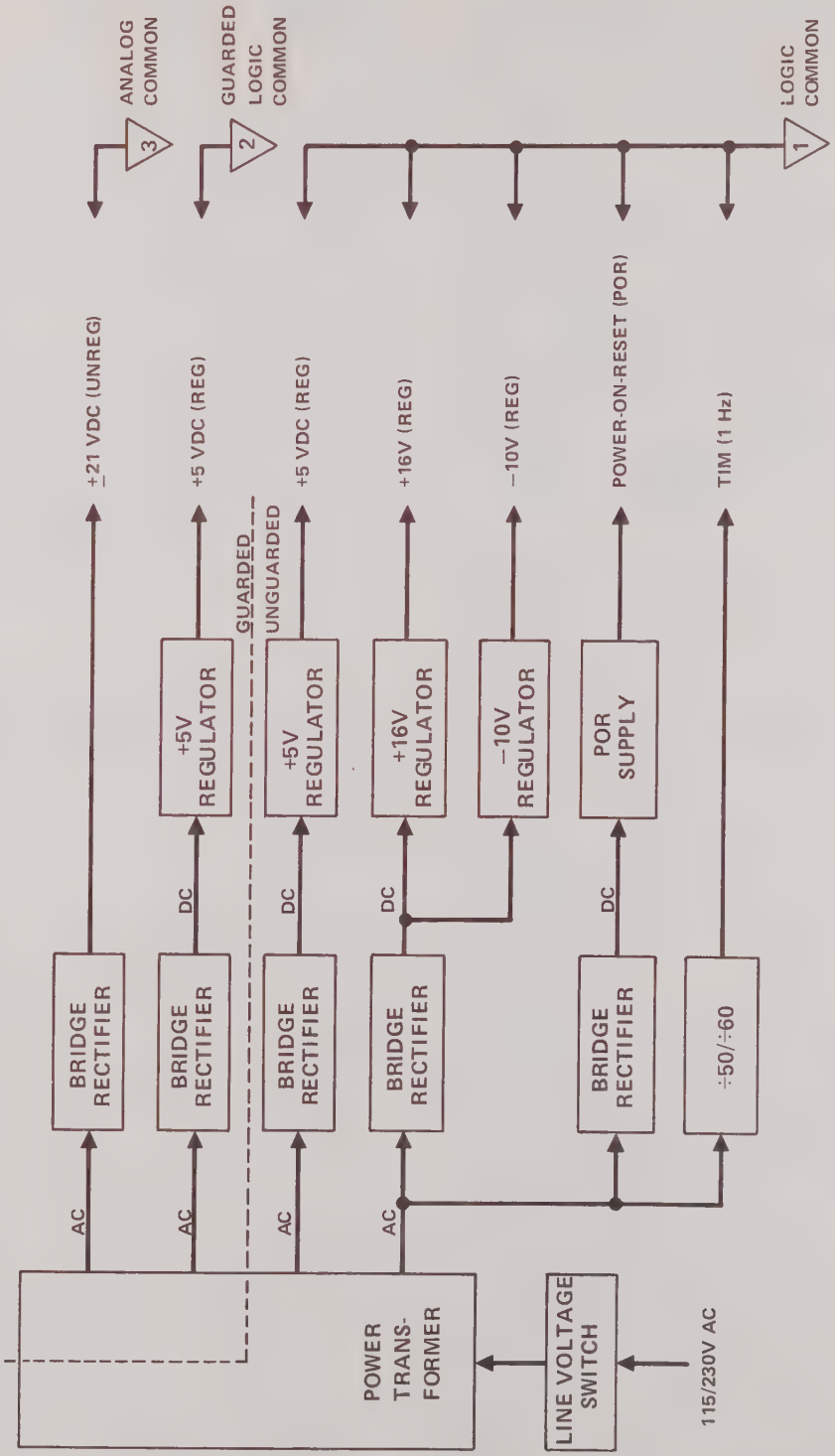

Figure 3-9. Power Supply, Simplified Block Diagram

set to divide by the actual line frequency (50 or 60 Hz) it generates a 1 Hz pulse as an output. The pulse is buffered and provided as a power supply output signal (TIM) for use by the Controller for updating date and time entries.

3-64. The Power-On-Reset (POR) signal serves as a reset command to initialize the system when power is initially turned-on, or when line power is restored after a power failure. POR is generated by a fast-acting unregulated supply whose output is normally low during power off. When line power is initially applied, POR remains low for approximately 600 ms (reset period) and then goes high (+5V dc). The signal is adequately buffered for use in resetting all data logger logic.

3-65. Range and Function Memory PCB Assembly

3-66. The Range and Function Memory PCB Assembly is a Controller peripheral designed to operate as a non-volitile memory for storing the programmed range/function and limit address (A and B) for each channel controlled by the data logger. Since the basic data logger cannot control more than 128 channels, and since limit addresses are only useful when one or more of the limits options (—21 or —22) are installed, only the Function memory (U10) for channels 0-127 is included with the basic data logger. When a Program Memory Option (—20) or one or more limit options (—21, —22) are installed, the Range and Function memory must be expanded. This is accomplished by installing one or more 512 x 1 RAM's in the appropriate IC sockets on the Range and Function Memory PCB Assembly.

3-67. The normally volitile RAM's are made non-volitile by supplementing the unguarded +16V dc power supply with a 5.9V lithium battery. If the system power fails or is turned off, the battery is switched into service and maintains the data in memory. When power is restored the batteries are effectively removed from the circuit and the unguarded +16V dc power supply resumes the burden of supplying operating power to the RAM's. Under normal operating conditions battery life is five years, minimum.

3-68. The Range and Function Memory PCB Assembly, as shown in Figure 3-10, is capable of recognizing and responding to any one of seven control codes which appear on Control Bus B. These include one memory-address code (Channel Address Receive), three read-memory codes (transmit) and three write-into-memory codes (receive). (See Table 3-1 for a complete list of Control Bus Codes.) A memory address code always preceeds a read or write operation and is used to allow the Controller to specify a particular memory location (channel) via the Data Bus. After the memory is addressed, the Controller specifies either the read or write function (via the Control Bus) and the type of data involved, i.e., range and function, limit A address, or limit B address. The next Sync pulse from the Controller allows the pcb assembly to initiate an internally clocked sequence which complies with the code present on the Control Bus. Clock pulses for these sequences are derived from a 165 kHz, 2-phase clock generator which is an integral part of the Range and Function Memory PCB Assembly.

3-69. The memory address sequence is initiated when the Controller places a binary coded 4, onto Control Bus B. The code is detected by a control-bus decoder on the Range and Function Memory PCB, and is used to enable a series of four 2-bit shift registers. Address data is presented to the registers, via the Data Bus, as two 4-bit characters. Each character is loaded into the registers by accompanying Out Strobe pulses from the Controller. After the second address character is entered, the Controller removes the binary coded 4 from the Control Bus and, thereby, terminates the memory address sequence.

3-70. Stored address data operates in conjunction with control bus data to address a particular memory location for read and write sequences. The first seven bits of stored address data (A2-A8) are combined with the outputs (A0 and A1) of a two-bit binary counter to provide a nine-bit binary address code (512 individual addresses) to each of the six possible RAM's which comprise the program memory. The eighth bit of address dta (A9) is combined with two bits of control bus data (CB0 and CB1) at the RAM enable decoder to define which one of the six RAM locations will be enabled during a red or write sequence. Control bus data CB0 and CB1 define one-of-three program functions: range and function data (01), limit A address (10) and limit B address (11).

3-71. Both the read and write sequences begin in a smilar manner. First, either a read code (binary coded 1, 2 or 3) or a write code (binary coded 5, 6 or 7) is placed onto Control Bus B by the Controller. Then bits 1, 2, and 8 of this code (CB0, CB1 and CB3) are analyzed by the control bus decoder to ensure that the following conditions are met: bit 8 (CB3) is low and either or both bits 1 and 2 (CB0 and CB1) are high. If these conditions exist, the leading edge of the next Sync pulse (from the Controller) causes the decoder to enable (E1) the read/write portion of the control logic. (See write timing diagram in Figure 3-11). This in turn, allows the control logic to analyze the state of the 4-bit (CB2) which is high during the presence of a write code at the control bus, and low for a read code. If a write code is detected, the remainder of the sequence is executed as a write sequence. Conversely, a read sequence is executed if CB2 is low.

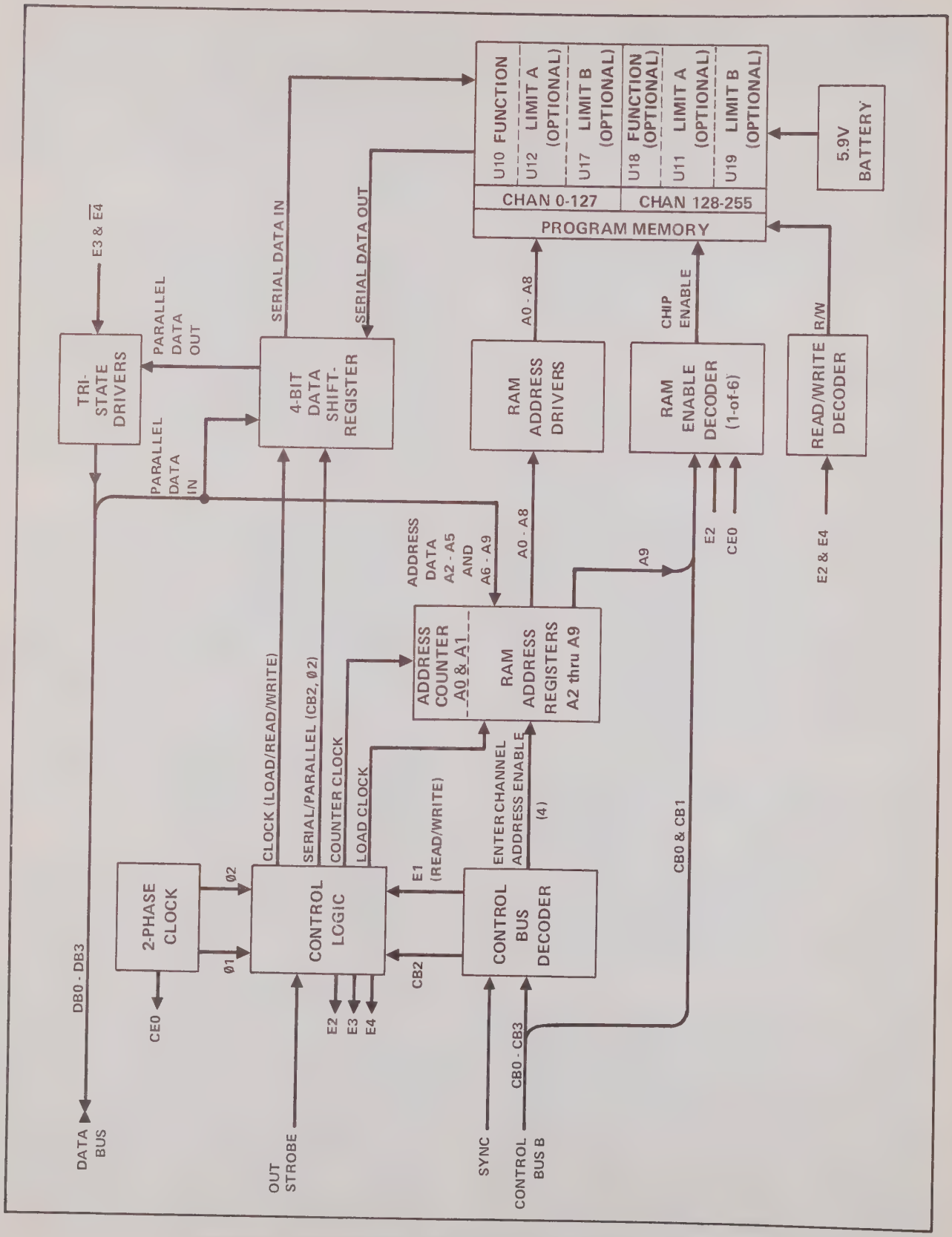

Figure 3-10. Range and Function Memory, Simplified Block Diagram

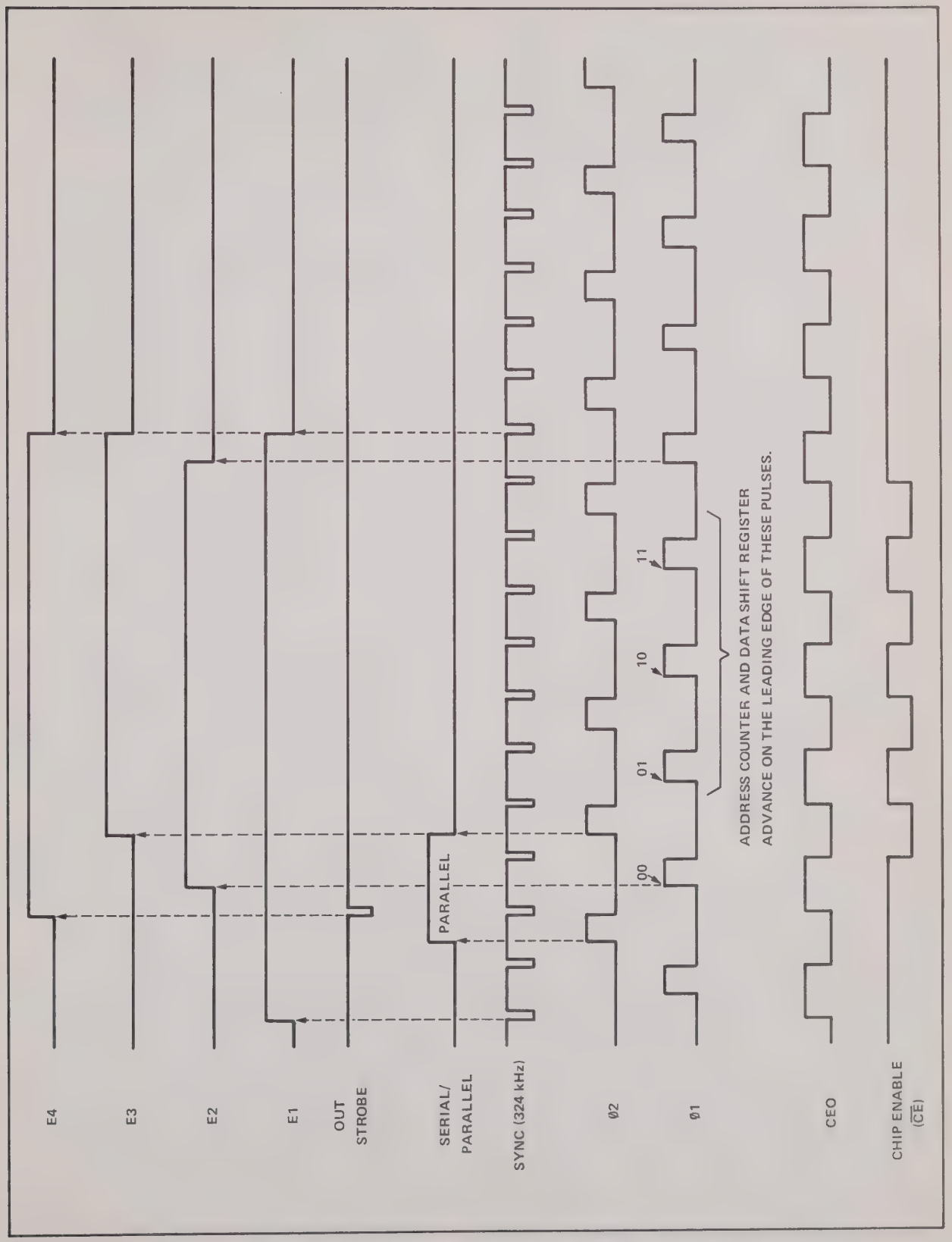

Figure 3-11. Range and Function Memory Write Sequence Timing Diagram

3-72. When a write sequence is indicated (i.e., both E1 and CB2 are high), the leading edge of the next Ø2 clock causes the Control Logic to generate a parallel mode command to the 4-bit data shift register. On the leading edge of the next Out strobe from the Controller, the Control Logic generates an E4 (enable write mode) output and a load clock. The load clock enters parallel data (DB0-DB3) from the Data Bus (as supplied by the Controller) into the 4-bit data shift register. With E4 high the Control Logic allows the leading-edge of the next Ø1 clock to generate a high E2 output. When both E2 and E4 are high the following circuits are affected: the two-bit counter (A0 and A1) in the RAM address register is enabled, the read/write decoder generates a write enable input to the program memory, and the control logic prepares to generate an E3 output, as well as a serial mode command (to the 4-bit data shift register). On the trailing edge of the Ø1 clock, CE0 (Chip Enable) goes low causing the first bit of data (DB0) in the four bit data shift register to be written into the addressed memory location. While CE0 is still low the leading edge of the Ø2 clock pulse occurs. This causes the E3 output to go high and the serial mode command to the 4-bit data shift register to be initiated. On the leading edge of each of the next three Ø1 clock pulses both the 4-bit data shift register and the address counter are incremented. Thus, as CE0 makes its negative transition each of the remaining three bits of input data are written into consecutive address locations in the program memory. When the address counter achieves a binary count of 3(11) is causes the leading edge of the next Ø1 clock pulse to reset the E2 output. This effectively ends the write sequence by inhibiting subsequent circuit reactions to the 2-phase clock outputs (Ø1, Ø2, and CE0). When the Controller removes the write code from the Control Bus the leading edge of the next Sync pulse resets the E1 output which clears the remainder of the control logic.

3-73. When a read sequence is indicated (i.e., E1 is high and CB2 is low), outputs E2 and E3 are sequentially clocked to the high state as shown in Figure 3-12. Notice that throughout the sequence, output E4 remains continuously low. This inaction on the part of E4 distinguishes the read sequence from the write sequence by enabling the following events: the Ø2 clock to selected as the read clock is serially shift RAM data into the 4-bit data shift register, the tri-state drivers are enabled for the duration of the E3 output to place parallel read data from the data shift register onto the data bus, the RAM's read/write inputs are commanded to read. As a result, when the chip enable signal ($\overline{CE}$) goes low, the data from the addressed memory location appears on the program memory's serial data output line. On the leading edge of the Ø2 clock the data is shifted into the data shift register. Chip enable ($\overline{CE}$) returns high and is followed by a Ø1 clock which advances the two-bit address counter. This read cycle is repeated until the full four-bit word has been transferred from memory into the data shift register. At that time the address counter has reached a count of binary coded 3. This allows the following Ø1 clock to reset the E2 output low. The read sequence is then terminated on the leading edge of the next Sync pulse (i.e., outputs E1 and E3 are returned to their low state).

3-74. Guard Crossing PCB Assembly

3-75. The Guard Crossing PCB Assembly operates in conjunction with either the General Purpose A/D Converter (Option —09) or the High Performance A/D Converter (Option —10) to provide the data logger with guarded, programmable, a/d voltage-measurement capability. Functions performed by the Guard Crossing PCB in this operation include: electrical isolation of the guarded input section of the data logger from the unguarded digital control section, and digital control for the analog half of the dual-slope a/d converter (i.e., a/d control logic, crystal controlled clock, and main counter string). The theory of operation given herein describes the isolation and digital I/O functions performed by the Guard Crossing PCB Assembly, but does not include the theory of operation for the dual-slope a/d conversion process. This is described in detail in Section 6 of this manual under the a/d converter options —09 and —10, as applicable.

3-76. The Guard Crossing PCB Assembly, as shown in Figure 3-13, operates as a Controller peripheral and is capable of both receiving and transmitting data via the Data Bus. In the receive mode, channel and range programming data is accepted from the Controller, transferred across the guard crossing, and presented to the a/d converter. In the transmit mode, status or measurement data from the digital section of the a/d converter is transferred across the guard and presented to the Controller. The required operating mode is enabled when the appropriate address code is present on Control Bus A, and is executed under the direction of control signals received from the Controller.

3-77. The receive mode is enabled when the Controller places a binary coded 2 on Control Bus A. Input data from the Controller is received in character-serial format (four 4-bit characters) on the Data Bus (DB0 through DB3) and temporarily entered into storage in the channel and range latch by the Out strobe. Once stored, the character is optically transmitted across the guard, buffered, and presented to the a/d converter option (—09 or —10) as channel and range control data. As each character crosses the guard, it is followed by a 10 μs Receive clock. The clock is derived from the Out strobe and is generated by the receive clock logic. On the guarded side of the pcb, the Receive clock increments a four-bit shift register, the output of which, addresses

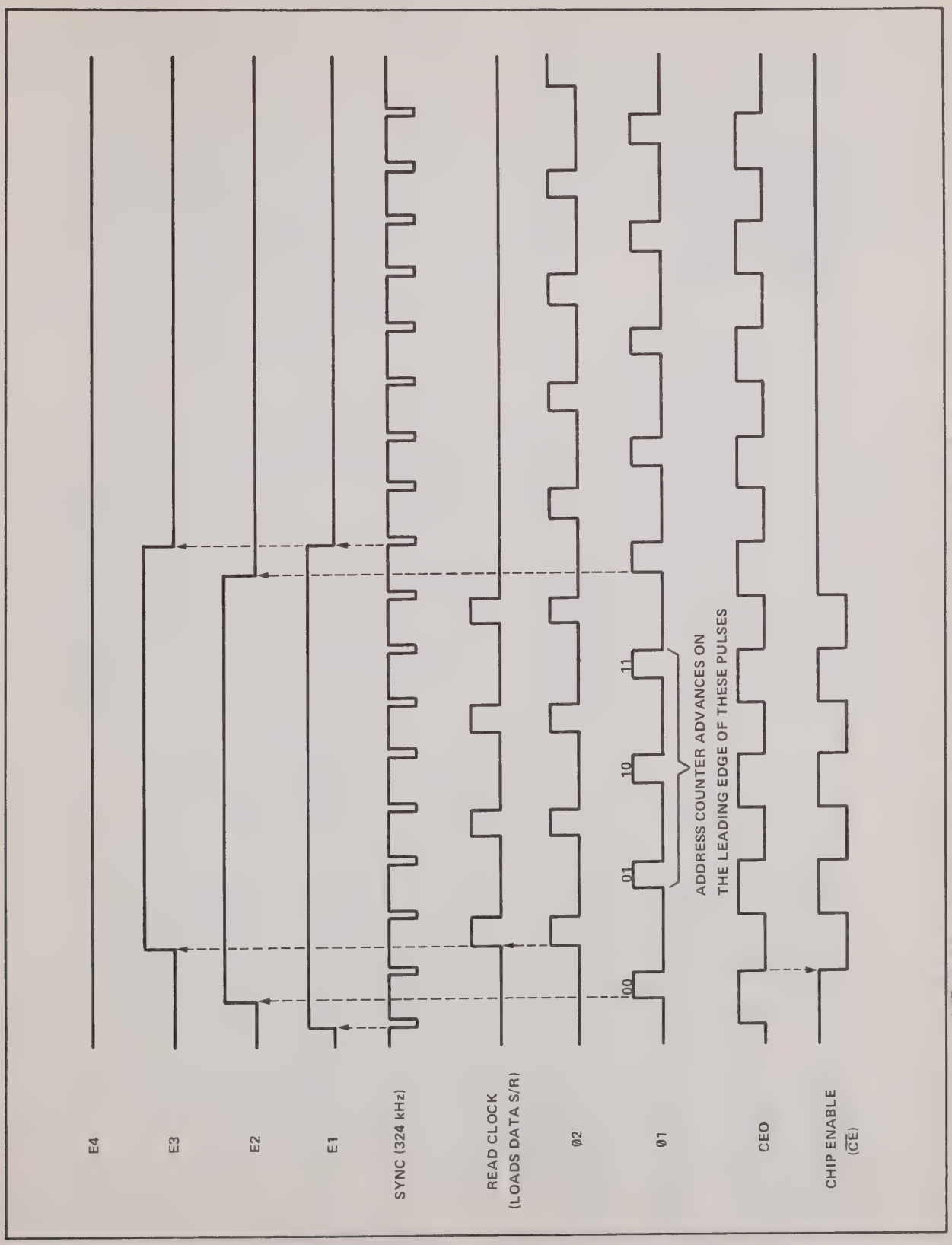

Figure 3-12. Range and Function Memory Read Sequence Timing Diagram

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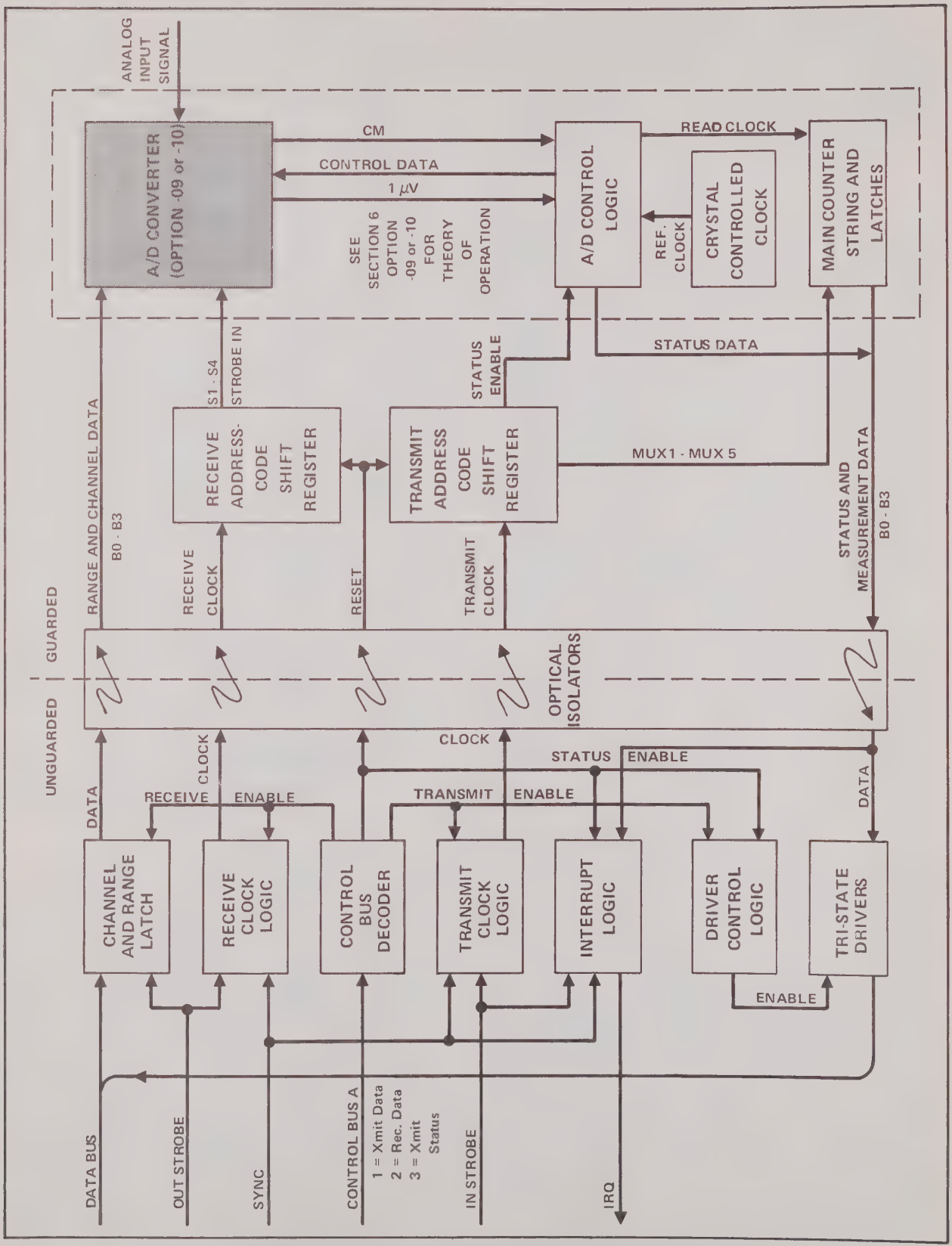


Figure 3-13. Guard Crossing, Simplified Block Diagram

range (S1) and channel storage (S2, S3 and S4) locations on the a/d converter option. Data entered into these locations define the channel to be measured and the measurement range to be used.

3-78. The transmit status mode is enabled when the Controller places a binary coded 3 on Control Bus A. During the presence of this code, the control bus decoder generates a Status Enable signal which is used to perform three separate functions. First, it is transmitted across the guard where it is used to reset (initialize) both the transmit and receive address code shift registers. Second, it enables the tri-state drivers which allow transmitted data to be placed onto the Data Bus. Third, it allows the next In strobe to reset the Interrupt Logic and, thereby, clear the interrupt request line (IRQ).

3-79. When the tri-state drives are enabled and the two address code registers are reset, status information is allowed to appear on the Data Bus as a single four-bit output character. Three separate characters are employed to indicate each of the following status conditions: measurement data ready, new channel and function data required for next measurement, and 1 μV signal. All three of these codes are derived from the a/d control logic portion of the Guard Crossing. The new-data-required and data-ready status conditions are keyed to the beginning and end, respectively, of each measurement cycle. The 1 μV signal is transmitted only once (during the initial power-on) and is used to inform the Controller of the type of A/D Converter installed (General Purpose A/D Converter, —09; or the High Performance A/D Converter, —10).

3-80. When the a/d converter completes a measurement cycle it notifies the Controller by setting the Interrupt Logic and pulling the IRQ line low. The Controller responds by serially interrogating the status of the Printer Drive, the output options, and the Guard Crossing PCB Assemblies, to determine which of the three random responding units pulled the IRQ line low. When the Guard Crossing PCB is interrogated, it indicates that measurement data is ready to be transmitted. The Controller responds by terminating the status transmit mode and enabling the transmit data mode.

3-81. The transmit data mode is enabled when the Controller places a binary coded 1 code on Control Bus A. While the code is present on the Control Bus, it causes the control bus decoder to generate a Transmit Enable signal. This signal, in turn, enables the tri-state drivers and the transmit clock logic. The next In strobe from the Controller is passed through the transmit clock logic, coupled across the guard and used to set the first position of a five-bit shift register. Each subsequent In strobe is used to advance the shift register position and, thereby, sequentially address a five-channel multiplexer (main counter string and latches) in which measurement data is stored (MUX1-MUX5). As each channel of data is addressed (LSD first, MSD last), it is placed onto the guarded side of the data bus (B0 through B3), transmitted across the guard, and presented to the Data Bus through the enabled tri-state drivers. Each character is read into the Controller on the trailing edge of the In strobe.

Section 4
Maintenance

WARNING!

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2240A Data Logger. This includes service information, general maintenance, and a performance test. The performance test is recommended as an acceptance test when the instrument is first received, and later as a preventive maintenance tool to verify proper instrument operation, when necessary. A calibration cycle of 1 year is recommended to maintain the 2240A within the 1-year specifications. If the 90-day specifications are to be maintained, a 90-day calibration cycle is recommended. Table 4-1 lists the recommended test equipment necessary to execute the performance test and calibration procedures. If the specified equipment is not available, alternate equipment having equivalent specifications may be substituted.

Table 4-1. Recommended Test Equipment

INSTRUMENT	RECOMMENDED MODEL
DC Voltage Calibrator	Fluke 343A
DVM	Fluke 8000A
Low Level Scanner	Fluke Option —06
Input Connector	Fluke Option —07 or —08

4-3. SERVICE INFORMATION

4-4. The 2240A is warranted for a period of 1 year upon delivery to the original purchase. The WARRANTY is given on the back of the title page located in the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included with the WARRANTY. Shipping information is given in Section 2 of this manual. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Access Information

WARNING

LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2240A IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS AND SCANNERS PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

4-8. CALIBRATION ADJUSTMENTS

4-9. All calibration adjustments and all plug-in options within the data logger can be accessed for maintenance purposes by removing the top dust cover and the two inner covers located in the top rear of the instrument. Six Phillips head screws hold the top dust cover in place.

4-10. SEIKO MODEL 102 PRINTER HEAD

4-11. Use the following procedure to remove the printer head from the 2240A:

a. Remove the top dust cover from the 2240A.

b. Locate the hinges for the printer's front panel assembly and, with the panel closed, apply pressure, using a thumb or finger, to the rear of one of the hinges. The hinge will snap apart.

c. Using a lateral motion, separate the other hinge and remove the printer's front panel.

d. Disconnect the printer's cable and connector assembly from the Printer Driver PCB. (The cable is located at the bottom of the printer bulkhead.)

e. Remove the four large mounting screws at the rear of the printer bulkhead. Support the printer with one hand while removing these screws. (The use of an offset Phillips-head screwdriver is suggested.)

f. Fully extend the paper drawer and work the top of the printer through the front panel opening. Tilt the printer forward and rest it on the paper drawer.

g. Push the cable through the bulkhead bushing and cable clamp to obtain about 4 to 5-inches of free cable at the printer.

h. Remove the printer's cable clamp and cable bushing from the printer bulkhead.

i. Remove the cable from the bushing slot and slide both the cable and connector past the extended printer drawer.

j. Logically reverse this procedure to install the printer head.

4-12. Cleaning

4-13. Clean the Model 2240A periodically to remove dust, grease and other contamination. Separate procedures are given below for cleaning the Seiko Model 102 Printer Head, and the 2240A cables and pcb's.

4-14. SEIKO MODEL 102 PRINTER HEAD

4-15. The printer should be cleaned after using 10 packs of paper or every 90-days. Use the following procedure:

a. Remove the printer head from the chassis using the procedure given in paragraph 4-10.

b. Use a brush or vacuum cleaner to remove dust and other clinging particles.

c. Clean the face of the print drum using a hard bristle brush.

d. Use alcohol or benzine to remove grease and grime from the printer.

CAUTION

The use of thinner, tri-chlorothelene, ketone, etc., may cause damage to plastic parts on the printer.

4-16. CABLE AND PCB'S

4-17. Use the following procedure to clean the interface cables and pcb's used with the data logger.

a. Clean the cables with a soft cloth dampened with a mild solution of detergent and water.

b. Clean the surface of the pcb's using clean dry air at low pressure (≤20 psi). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with clean, dry air at low pressure.

4-18. Lubrication

4-19. The Seiko Model 102 Printer should be lubricated every 6 months under normal use conditions and, if necessary, after cleaning. Refer to Figure 4-1 and apply the specified lubricant, O2 or G2, to the points indicated. Use a syringe for hard-to-reach lubrication points.

NOTE

The required lubricants, O2 and G2, can be purchased from: Itronics Lab., 381 Beach Rd. Burlingame, CA. 94010. Telephone: 415-342-6712.

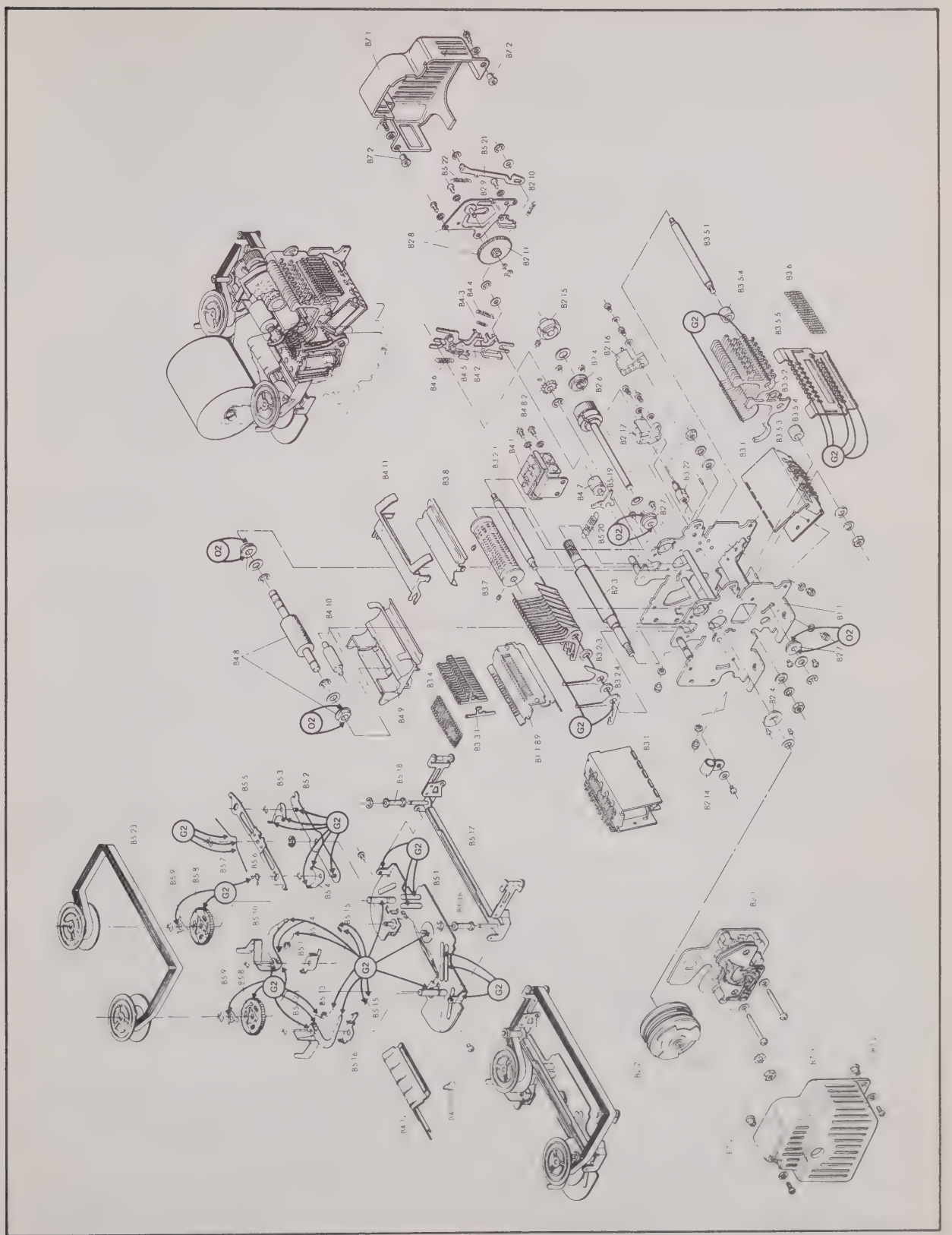


Figure 4-1. Lubrication Chart

4-20. Fuse Replacement

4-21. The power fuse is located on the rear panel of the data logger. If replacement is necessary, select the fuse rating according to the local line voltage as listed below:

WARNING

DISCONNECT THE UNIT FROM LINE POWER BEFORE ATTEMPTING FUSE REPLACEMENT.

1. 100V ac — 3/4A Slo Blo
2. 115V ac — 3/4A Slo-Blo
3. 230V ac — 3/8A Slo-Blo

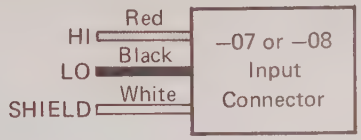
NOTE

The fuse holder cap can be replaced with a metric cap (John Fluke P/N 424440) which will accept 5 mm x 20 mm fuses.

4-22. Service Tools

4-23. A special interface cable is required to execute the Performance Test given later in this section. The cable is fabricated using either of the available input connectors, (Option —07 or —08) and a length of 20 gauge insulated wire. The instructions necessary to fabricate the cable are given in Figure 4-2.

4-24. A set of PCB Extender Cables are available for servicing the plug-in pcb's contained in the data logger. The Extender Cables are available as accessories and are described in Section 6, Option and Accessory Information.



Use the following procedure to prepare the above test cable:

1. Cut a 24-inch length of each of the following wires. Use insulated, 20 guage, standard wire:
   a. Red
   b. Black
   c. White
2. Refer to the connector decal for pin locations and connect the wires from step 1 to the following connector inputs:
   a. Red wire to HI-0 and HI-5.
   b. Black wire to LO-0 and LO-5.
   c. White wire to SH-0 and SH-5.
3. Strip ½ inch of insulation from the free ends of the red, black and white wires, and tin the exposed wire.
4. Install the following jumpers on the input connector. Use bare copper hook-up wire:
   a. LO-1 to HI-1
   b. LO-2 to HI-2
   c. LO-3 to HI-3
   d. LO-4 to HI-4
   e. LO-6 to HI-6
   f. LO-7 to HI-7
   g. LO-8 to HI-8
   h. LO-9 to HI-9

Figure 4-2. 2240A Test Cable

4-25. PERFORMANCE TEST

4-26. The performance test is designed to verify the overall operation of the 2240A, and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 4-1. The entire test should be executed in the sequence given. If the 2240A fails any part of the performance test, corrective action is indicated. Troubleshooting information is given at the end of the this section.

4-27. Set-Up Procedure

4-28. Prior to executing the performance test complete the following set-up procedure:

a. Install a Low Level Scanner (Option —06) in slot 0 (Channel 0-9) of the 2240A. The dust cover and the left-rear inner guard should be removed for the duration of the performance test.

b. Attach the test cable described earlier under Service Tools to the scanner in slot 0.

c. Connect the free end of the test cable to the output of the DC Voltage Calibrator (Red to +, Black to –, and White to ground).

d. Set the DC Voltage Calibrator for a 0V dc output.

e. Energize the DC Voltage Calibrator.

f. Press the RESET switch in the 2240's SCAN CONTROL group.

g. Press the ALL DATA switch in the PRINTER ENABLE group. Release all other switches in the OUTPUT CONTROL group.

h. Connect the 2240A to line power and set the Power switch to POWER ON. The DATA display should read 2240A 1 (or 2) for ≈3 seconds and then begin to read elapsed time. The POWER FAILURE RE-ENTER TIME lamp in the TIME ENTRY group should begin to flash.

4-29. Display and Data Entry Test

4-30. Use the following procedure to check the operation of the 2240A display and Data Entry switches:

a. Complete the Set-Up Procedure.

b. Press the FIXED DATA switch in the SCAN FORMAT group. All annunciators and the CHANNEL display should be out. The fixed data currently in memory should appear at the DATA display.

c. Using the DATA ENTRY keyboard, enter a series of six 1's. The DATA display should read 111111.

d. Press CLEAR ENTRY switch and enter six 2's on the keyboard. The DATA display should read 222222.

e. Press CLEAR ENTRY switch and repeat the previous step using a series of 3's, 4's, 5's, 6's, 7's, 8's, 9's and 0's. The entered data should appear on the DATA display.

f. Press the MONITOR CHANNEL switch in the SCAN FORMAT group. The monitor channel currently in memory should appear at the CHANNEL display.

g. Using the DATA ENTRY keyboard enter a series of three 1's. The CHANNEL display should read 111.

h. Press CLEAR ENTRY switch and enter three 2's on the keyboard. The CHANNEL display should read 222.

i. Press CLEAR ENTRY switch and repeat the previous step using a series of 3's, 4's, 5's, 6's, 7's, 8's, 9's and 0's. The entered data should appear on the CHANNEL display.

4-31. Date and Time Test

4-32. Use the following procedure to check the operation of the time-of-year clock.

a. Press the DAYS switch in the TIME ENTRY group. All annunciators and the DATA display should be out. The day code currently in memory should appear on the DAY (CHANNEL) display (000 if day code has not been entered since power was turned on).

b. Using the DATA ENTRY keyboard, enter 222 and press the ENTER/STEP switch. The DAY display should read 222 along with hours, minutes and seconds on the DATA display. The power failure LED should no longer flash.

c. Press the HR:MIN:SEC switch in the TIME ENTRY group. The DAY display should go out and the DATA display should go out and the DATA display should read the time-of-day currently in memory.

d. Using the DATA ENTRY keyboard, enter 235950. The entered data should appear on the DATA display as 23 hours, 59 minutes and 50 seconds.

e. Press the ENTER/STEP switch and observe the display. The clock should start running the instant the ENTER/STEP switch is pressed. When the clock makes the transition from 23:59:59: to 00:00:00 ensure that the DAY display changes from 222 to 223.

f. Press HR:MIN:SEC in the TIME ENTRY group and enter 489999 on the DATA ENTRY keyboard.

g. Press the ENTER/STEP switch while observing the display. The reading should change to 225 01:40:40 and begin counting.

4-33. Scan Format Test

4-34. Use the following procedure to check the operation of the SCAN FORMAT switches and the associated memory.

a. Press the FIXED DATA switch in the SCAN FORMAT group.

b. Using the DATA ENTRY keyboard, enter 123456 and press the ENTER/STEP switch.

c. Press the FIRST CHANNEL switch in the SCAN FORMAT group. The first channel currently in memory will be displayed.

d. Enter 0 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The CHANNEL DISPLAY should read 000.

e. Press the LAST CHANNEL switch in the SCAN FORMAT group. The last channel currently in memory will be displayed.

f. Enter 59 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The CHANNEL DISPLAY should read 059.

g. Press the INTERVAL HR:MIN:SEC switch in the SCAN FORMAT group. The time interval currently in memory will be displayed in HR:MIN:SEC on the DATA display.

h. Enter 10 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The DATA DISPLAY should read 00.00.10.

i. Press the MONITOR CHANNEL switch in the SCAN FORMAT group. The CHANNEL display should read the monitor channel currently in memory.

j. Enter 5 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The CHANNEL display should read 005.

k. Starting with FIXED DATA sequentially press each switch in the SCAN FORMAT group and ensure that the previously entered data is displayed.

l. Set the Power switch to POWER OFF for at least 1 minute and then set it to POWER ON. The POWER FAILURE RE-ENTER TIME lamp should begin to flash.

m. Repeat step k.

n. Reset the POWER FAILURE RE-ENTER TIME lamp by pressing the DAY or HR:MIN: SEC switch in the TIME ENTRY group and the ENTER/STEP switch on the DATA ENTRY keyboard.

4-35. Channel Programming Test

4-36. Use the following procedure to check the operation of the Channel Programming circuits:

a. Press the PROGRAM LIST switch. The printer should print the date and time; interval in hours, minutes, and seconds; fixed data; the monitor channel; and all available limit addresses (30 max.) and their assigned values. This data is then followed by a list of all channels within the limits defined by the scan format. The assigned measurement function and scale is printed on the channel line. If limits data has been assigned to the channel, the limit address, high (>) or low (<) sense, and the limit value is printed on the line following the channel data. If a channel is programmed to skip, function, scale, and limits data will not accompany the channel number.

b. Press the ENABLE switch in the CHANNEL PROGRAMMING group and enter the number of the first channel listed by the printer. Press the ENTER/STEP switch. The ENTER FUNCTION lamp should light.

c. Press the SKIP switch on the DATA ENTRY keyboard and then press the ENTER/STEP switch.

d. Identify the next channel printed on the program list and enter it on the DATA ENTRY keyboard.

NOTE

When practical, use the ADVANCE ADDRESS switch to call up the next applicable channel.

e. Press the REPEAT switch in the CHANNEL PROGRAMMING switch group.

f. Repeat steps d and e of this procedure for all remaining channels listed by the printer.

g. Press the PROGRAM LIST switch. Heading data, limits data and channel numbers will be printed. However, channel function data will not be printed.

h. Press the ENABLE switch in the CHANNEL PROGRAMMING group and enter an address of 0.

i. Press the ENTER/STEP switch. The ENTER FUNCTION lamp should light.

j. Select the 4V function on the DATA ENTRY keyboard and press the ENTER/STEP switch.

k. If the Limit Options are installed, press the SKIP and ENTER/STEP switches for both LIMIT A and LIMIT B. The CHANNEL ENTER ADDRESS lamp should light.

l. Enter an address of 5 using the DATA ENTRY keyboard and press the ENTER/STEP switch.

m. Press the REPEAT switch.

n. Call the following channel addresses using the DATA ENTRY and ENTER/STEP switches, and press the REPEAT switch after each is entered: 10, 15, 20, 25, 30, 35, 40, 45, 50, 55.

o. Press the PROGRAM LIST switch. The standard heading and each of the programmed channels and their function should be printed.

p. Set the Power switch to POWER OFF for 1 minute and then set it to POWER ON.

q. Repeat step o. Program data should not change.

4-37. Scan Control Test

4-38. The following procedure checks the operation of the 2240A scan control logic and measurement circuitry:

NOTE

This procedure assumes that the data entered during the Scan Format and Channel Programming checks is still in memory.

a. Adjust the calibrator for an output of 1.0000V dc.

b. Press the SINGLE switch in the SCAN CONTROL group. The printer should record inputs of 1.0000V dc at channels 0 and 5, and ≈0V dc at all channels that have not been skipped.

c. Press the STOP/RESET switch in the SCAN CONTROL group.

d. Press LAST CHANNEL in the SCAN FORMAT group, then press 9 and ENTER/STEP on the DATA ENTRY keyboard.

e. Set the DC Voltage Calibrator for an output of 2.0000V dc.

f. Press the INTERVAL switch in the SCAN CONTROL group. The printer should record a 2.0000V dc reading for channels 0 and 5. The scan-cycle start should repeat itself at the programmed interval (10 sec).

g. Press the MONITOR switch in the SCAN CONTROL group. The display should indicate a 2.0000V dc input to channel 5.

h. Increase the calibrator output to 5.0V dc. The DATA display should read uuuuu to indicate the presence of an overrange voltage.

i. Press the CONTINUOUS switch in the SCAN CONTROL group. The printer should print :,- -:-V for both channels 0 and 5 to indicate the presence of an overrange voltage. The scan cycle should continue to repeat with a minimum time between the end of one cycle and the start of the next.

j. Press the STOP/RESET switch in the SCAN CONTROL group.

4-39. Output Control Test

4-40. Use the following procedure to check the operation of the OUTPUT CONTROL logic:

NOTE

This procedure assumes that the Scan Control Test has been completed and that the conditions existing at the end of that check are still present.

a. Press the LIMIT DATA switch in the PRINTER ENABLE group and release the ALL DATA switch.

b. Press the INTERVAL switch in the SCAN CONTROL group. The display should indicate an overrange for both channels 0 and 5, but the printer should not record data.

c. Reduce the output of the voltage calibrator to 3.9000V dc. The display should indicate 3.9000 volts for both channels 0 and 5, and the printer should not record data for either channel.

d. Press the INTERVAL DATA switch in the PRINTER ENABLE section of the OUTPUT CONTROL group. The printer should record the displayed data for channels 0 and 5 each time a scan sequence occurs.

e. Press the CONTINUOUS switch in the SCAN CONTROL group. The scan sequence should be continuously repeated, and data should be printed on the initial scan and every 10 seconds thereafter.

f. Press the RESET switch in the SCAN CONTROL group.

4-41. Display Control Test

4-42. Use the following procedure to check the operation of the DISPLAY CONTROL group.

NOTE

This procedure assumes that the Output Control Test has been completed and that the conditions existing at the end of that test are still present.

a. Release all switches in the PRINTER ENABLE section of the OUTPUT CONTROL group.

b. Press the CONTINUOUS switch in the SCAN CONTROL group. The data logger should alternately display channels 0 and 5 and their associated voltage readings (3.9000V).

c. Press the DATE AND TIME switch in the DISPLAY CONTROL logic. The display should read date and time. The clock should be running.

d. Press the MONITOR CHANNEL switch in the DISPLAY CONTROL group. The display should read channel 005 and its associated input voltage, (3.9000V).

e. Press the ALL CHANNELS switch in the DISPLAY CONTROL group. The display should alternately display channels 0 and 5 and their associated voltage readings.

f. Press the RESET switch in the SCAN CONTROL group.

4-43. A/D Converter Accuracy Test

4-44. Use the following procedure to check the operation of the a/d converter (Option —09 or —10).

NOTE

This procedure assumes that the Display Control Test has been completed and that the conditions existing at the end of that test are still present.

a. Set the calibrator output to 0V dc.

b. Press the MONITOR switch in the SCAN CONTROL switch group.

NOTE

If the High Performance A/D Converter (Option —10) is installed in the data logger, set its FAST/SLOW switch to SLOW.

c. Refer to Table 4-2 and sequentially enter each of the input voltage and data logger range combinations for channel 5 (monitor channel). As each entry is completed check the data logger display against the indicated display readings.

Table 4-2. A/D Converter Accuracy Test Specifications

Input Voltage	Range (Function)	Display Reading (90 day specification, 20°C - 30°C ambient)	
		General Purpose A/D and Scanner	High Performance A/D and Low Level Scanner (Slow Speed)
0.0V	40 mV	—	-0.005 to 0.005
0.0V	400 mV	-0.03 to 0.03	-0.02 to 0.02
0.0V	4V	-0.0002 to 0.0002	-0.0002 to 0.0002
0.0V	40V	—	-0.002 to 0.002
39.9 mV	40 mV	—	39.891 to 39.906
399 mV	400 mV	398.89 to 399.11	398.94 to 399.06
3.99V	4V	3.9890 to 3.9910	3.984 to 3.996
39.9V	40V	—	39.84 to 39.96

d. Disconnect the calibrator, and remove the test cable and the scanner from the 2240A.

e. Install the inner guard cover and the top dust cover.

f. Set 2240A POWER switch to OFF and disconnect line power.

4-45. CALIBRATION

4-46. The 2240A should be calibrated once every year or 90 days (as required to maintain desired accuracy) or whenever repairs have been made in the Power Supply or the A/D Converter (Option —09 or —10). Calibration should be accomplished at an ambient room temperature of +22 to +25°C and a relative humidity of less than 70%. Table 4-1 lists the required equipment.

4-47. Initial Procedure

a. Remove the top dust cover from the 2240A.

b. Press the RESET switch in the SCAN CONTROL group.

c. Connect the 2240A to line power and set the Power switch to ON.

d. Allow the 2240A to stabilize for a period of not less than 1 hour.

4-48. Power Supply

4-49. Use the following procedure to calibrate the Power Supply PCB:

a. Connect the DVM to TP1 (common) and TP2 (–10.2V dc) on the Power Supply PCB. See Figure 4-3.

b. Adjust pot R17 to obtain a reading of –10.20 ±0.05V dc.

c. Move the DVM input from TP2 to TP3. The DVM should read +5.1 ±0.2V dc.

d. Move the DVM input from TP3 to TP4. The DVM should read +16 ±1.0V dc.

4-50. A/D Converter (Option —09 or —10)

4-51. The 2240A may contain either-of-two A/D Converters; a general purpose version (Option —09) or a high performance version (Option —10). Refer to the appropriate subsection of Section 6 for calibration instructions.

4-52. Temperature and Scaling Option (Option —11)

4-53. The Temperature and Scaling option does not require calibration. However, its accuracy is dependent upon the calibration of the A/D Converter and the Isothermal Block Connectors.

4-54. Isothermal Block Connectors (Option —08)

4-55. The basic 2240A is capable of housing up to six Isothermal Block Connectors (Option —08) for use in conjunction with the Temperature and Scaling option (Option —11). Each Isothermal Block Connector has been calibrated at the factory and does not required periodic calibration. However, if a connector has been repaired or if the seal on the factory adjustment has been broken, calibration is required. Refer to subsection —08 in Section 6, Option and Accessory Information, for the calibration procedure.

4-56. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the 2240A. To prevent this possibility use the following precautions when troubleshooting and/or repairing the unit.

a. Never remove, install or otherwise connect or disconnect pcb's and/or components without first turning the 2240A Power switch to OFF.

b. Perform all repairs at a static free work station.

c. Do not handle IC's or pcb's by their connectors.

d. Use static ground straps to discharge repair personnel.

e. Use conductive foam to store replacement or removed IC's.

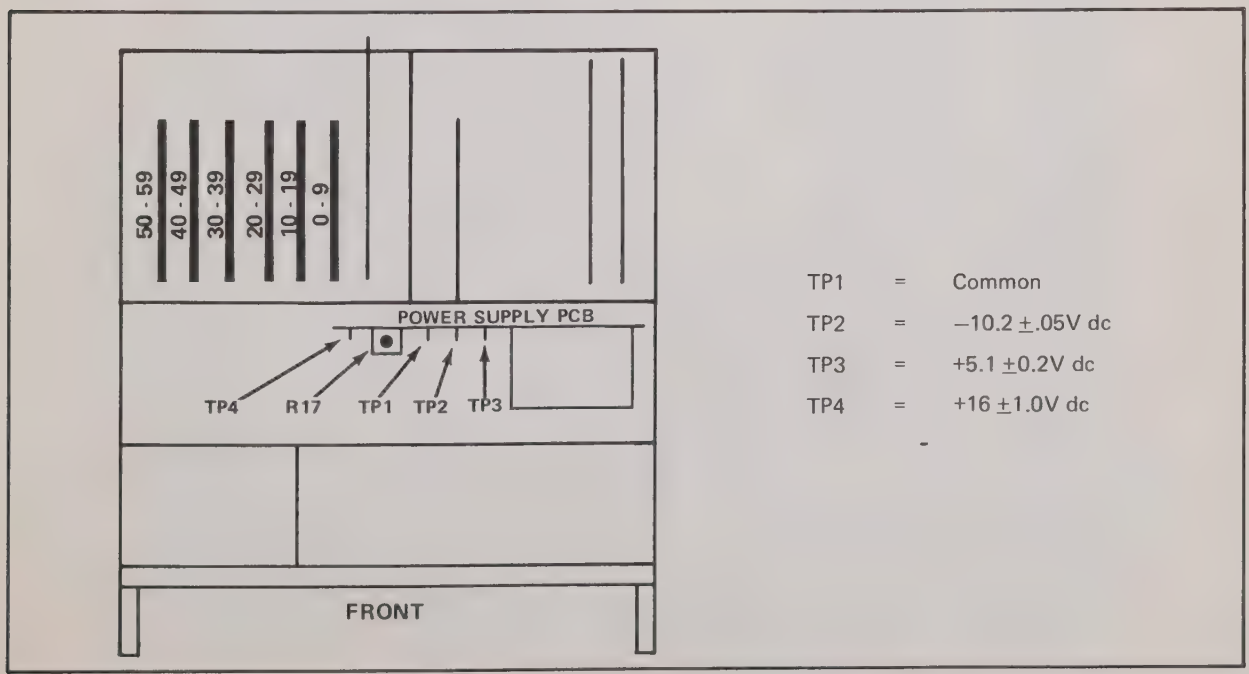


Figure 4-3. Power Supply Test Point and Adjustment Locations

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f. Remove all plastic, vinyl and styrafoam products from the work area.

g. Use a grounded soldering iron.

4-57. A troubleshooting guide for the 2240A is given in Table 4-3. The guide is in the form of a tabular flow chart and is recommended for use in isolating a 2240A mainframe malfunction to the pcb (board) level. Details necessary to troubleshoot faulty pcb's to the component level and be derived from the schematic diagrams given in Section 8 and the theory of operation in Section 3.

NOTE

Troubleshooting information for option pcb's is contained in the appropriate subsection of Section 6, Options and Accessories.

4-58. When troubleshooting the 2240A in accordance with Table 4-3 the following notes apply.

a. Do not start in the middle of the procedure. Any given step assumes that the previous steps have been completed.

b. All measurements using external test equipment are referenced to logic common (TP1 on Power Supply PCB) unless otherwise specified.

c. All connectors referenced for measurement are accessible from the bottom of the 2240A when the bottom dust cover is removed. See Figure 4-4 for connector and pin identification.

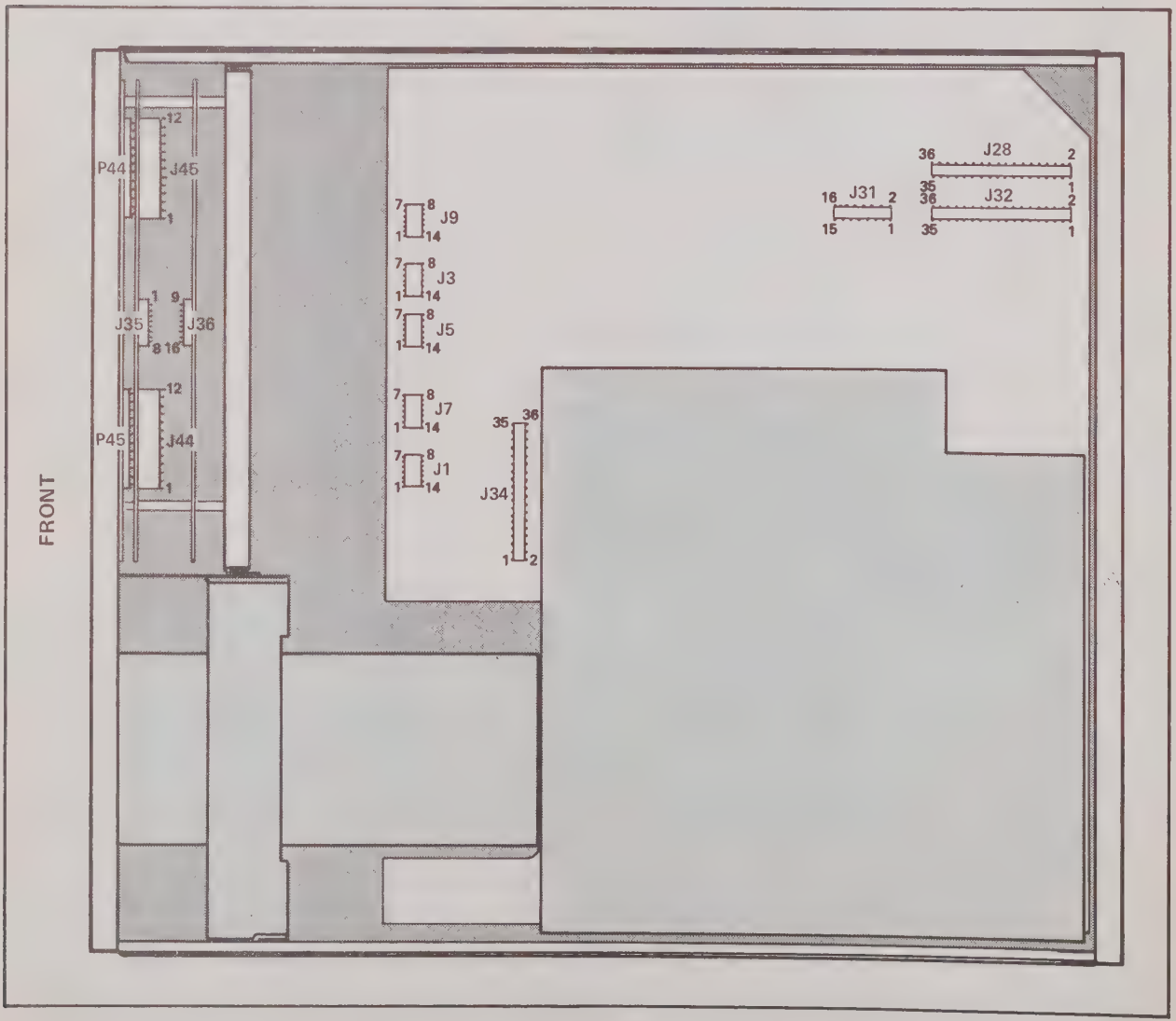


Figure 4-4. Measurement Point Locations For Troubleshooting

Table 4-3. Troubleshooting

STEP NO.	INSTRUCTION	YES	NO	GO TO
1.	Turn 2240A Power switch to OFF and disconnect power cord at rear panel.			2
2.	Remove the top and bottom dust covers, and the two inner guard covers from the 2240A.			3
3.	Remove all scanner pcb's and input connectors from the scanner section.			4
4.	Remove all option pcbs that may be installed in the digital I/O section.			5
5.	Remove the A/D Converter PCB and the Guard Crossing PCB.			6
6.	Disconnect the printer cable at the Printer Drive PCB.			7
7.	Connect the 2240A to line power and set the Power switch to POWER ON.			8
8.	Refer to procedure given in paragraph 4-47 and verify the presence and accuracy of all power supply voltages. If necessary: a. Isolate and relieve any shorted output conditions. b. Repair and/or calibrate the power supply.			9
	INITIAL TURN ON			
9.	Set the 2240A Power switch to POWER OFF, wait 10 seconds, and then to POWER ON. Observe the front panel display. Does it read 2240 1 (or 2)?	10	19	
10.	Does the display change to 00 0003 in approximately 3-seconds and begin to count-up?	11	14	
11.	Is the POWER FAILURE LED on or blinking?	12	15	
12.	Check the operation of the front panel keyboard. Do all keys appear to be operational?	13	18	
13.	Initial turn-on appears normal.			40
14.	If display continues to read 2240 1 (2) check for continuously low outputs on the following lines: Control Bus A — P32-7 (CA2) TIM — P32-31 (1 Hz square wave)			9
15.	Is the IMPROPER ENTRY LED blinking?	16	17	
16.	Check Control Bus B a P32-12 (CB3) for a continuously low condition.			9
17.	Check for presence of In strobe at P32-15.			9
18.	Check Control Bus B at P32-9 (CB0) and P32-10 for a continuously low condition.			9
19.	Does the display read a series of 1111's (may go blank after initial turn-on)?	20	27	
20.	Is the IMPROPER ENTRY LED blinking or on?	21	26	
21.	Is the POWER FAILURE LED blinking?	22	25	
22.	Does front panel keyboard appear to be operational?	23	24	
23.	If all PROGRAMMING LIMITS LED's are lit, check P32-16 for the presence of the Out strobe. Also check for continuously low A0 through A7 outputs of J9 (pins 1 through 4 and 11 through 14).			9
24.	Check Mode Switch PCB (U11 and U12).			9

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
25.	If limit program prompting LED's are on, 2Ø clock on Controller is defective. If limit program prompting LED's are off, check for continuously low IRQ line at J32-13.			9
26.	Check Control Bus A for continuously low outputs. P32-5, -6, -7, -8 (CA0, CA1, CA2, and CA3, respectively).			9
27.	Is the display blank upon turn on and remain blank?	28	33	
28.	Does the POWER FAILURE LED blink and the IMPROPER ENTRY LED off?	29	30	
29.	Check U19-3 (BI) on the Mode Switch PCB. If continuously high, check the operation of U4 and U1 and the associated circuitry on the Mode Switch PCB.			9
30.	Is the IMPROPER ENTRY LED blinking and the POWER FAIL LED off?	31	32	
31.	If the PROGRAMMING LIMITS prompting LED's are lit the Power-On-Reset (POR) signal from the Power Supply PCB (J32-18) is continuously low. If all annunciator LED's (mV, V, Temperature, Date and Time) are lit, check for a continuously low condition at J42-13(A) on the Mode Switch Assembly.			9
32.	Check for the presence of a continuously low SYNC pulse at J32-17.			9
33.	Does a series of three like characters appear in the CHANNEL display prior to the 3 second time out?	34	37	
34.	Does data display read 888880?	35	36	
35.	U9 on the Mode Switch Assembly and/or its associated circuitry is not operating.			9
36.	Check the Data Bus at P32-1, -2, -3 and -4 (DB0, DB1, DB2, and DB3, respectively) for the presence of a continuously low output.			9
37.	Does a series of three like-characters other than 000 appear in the CHANNEL display after the three second time out?	38	39	
38.	Check the operation of U5 on the Mode switch.			9
39.	If only one or two of the six display digits are lit check for a continuously low condition at J42-10, -11 and -12 (D, C, B) on the Mode Switch PCB Assembly.			9
	DISPLAY AND DATA ENTRY			
40.	Refer to paragraph 4-29 and complete the Display and Data Entry Test.			41
41.	Does the display and keyboard respond properly?	61	42	
42.	Does the keyboard appear to respond?	43	48	
43.	Are all digits in a series of entered numbers displayed the same, e.g., 111111, 222222, etc?	44	46	
44.	Are digits displayed as entered on both DATA and CHANNEL displays?	45	47	
45.	Defective Mode Switch Assembly, Repair as required.			40

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
46.	Some digits are blank or some character segments are not lit. Defective Display Assembly. Check U3 and U6 outputs. Check transistor drivers Q1 through Q11. Check LED elements by interchanging decades.			40
47.	Channel Display PCB is defective. Check U1 and U4. Repair as required.			40
48.	Make sure Power switch is set to POWER ON. Use scope to check for the presence of a 3 kHz clock at J45-4. Is clock present?	50	49	
49.	Keyboard Logic PCB is defective. Check for presence of +5V dc and the operation of oscillator formed by U11. Repair as required.			40
50.	Use scope to check for the presence of 1-2-4-8 outputs from binary counter. J45-10, -1, -8, -7 (1-2-4-8 respectively). Are counter outputs correct?	52	51	
51.	Defective Keyboard Logic PCB. Check U12 and U16. Repair as required.			40
52.	Use scope to monitor 3 kHz clock at P45-4 and individually press all front panel momentary type switches (not PAPER ADVANCE). The clock should stop when any one of the switches is depressed. Ignore order in which switches are pressed.			53
53.	Does clock stop for each switch that is pressed?	54	58	
54	Keyboard Switch Assembly is functional.			55
55.	Was a tone generated with any of the switch depressions?	57	56	
56.	Check for presence of In and Out strobe pulses at J35-3 and J35-2, respectively. If not present Controller is defective. If present, Control Bus B decoder on Keyboard Logic PCB Assembly is defective. Also check tone generator circuit on Keyboard Logic PCB. Repair as required.			40
57.	Check multiplexer operation of U6 and U7 on Keyboard Logic PCB Assembly. If okay, Controller is defective. Repair as required.			40
58.	Does clock stop for all switch depression except one or two?	59	60	
59.	Switch is defective on Keyboard Logic PCB Assembly.			40
60.	If clock does not stop for any switch depression, U1 on Keyboard Switch Assembly is defective. Repair as required.			52
61.	**SCAN FORMAT** Enter the following scan format data and observe the display as the ENTER/STEP switch is pressed for each entry. FIXED DATA — 123456 FIRST CHANNEL — 0 LAST CHANNEL — 10 INTERVAL — 10 seconds MONITOR CHANNEL — 5			62
62.	Does display data change or shift when the ENTER/STEP switch is pressed. (The addition of leading zeros is not considered a change in data?)	63	64	
63.	Check the following IC's on the Keyboard Memory PCB and repair as required: U1 — First, Last and Monitor Channels U2 — Fixed and Interval Data			61

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
64.	Set Power switch to POWER OFF, wait 1 minute, then return switch to POWER ON. Recall scan format data.			65
65.	Is recalled data the same as previously entered?	67	66	
66.	If recalled data comprises a series of 69's, the battery on the Keyboard Memory PCB is defective or switched off. Check switch position (located next to battery) and battery. Repair as required.			61
67.	Program channels 0 through 10 with the following function and limit address data. Function — 4V *LIMIT ADDRESS A — Skip *LIMIT ADDRESS B — Skip **Applicable only if the 2240A is equipped with limit option (-21, -22).*			68
68.	Did program prompting LED's react normally?	70	69	
69.	Defective Keyboard Switch and/or Logic PCB.			67
70.	Recall and verify the program data for channels 0 through 10.			71
71.	Is recalled data correct?	73	72	
72.	Memory IC's on Range and Function Memory PCB are defective. Try interchanging IC's and reprogramming to verify defect. Function IC's — U10 Channels 0-127, U18 Channels 128-999 Limit A Address IC's — U12 Channels 0-127, U11 Channels 128-999 Limit B Address IC's — U17 Channels 0-127, U19 Channels 128-999			67
73.	Sequentially press each of the SCAN CONTROL switches and observe the CHANNEL display to verify proper scanning operation in each mode. Ignore the DATA display characters. However, check the annunciator LED's to ensure that VOLTS is lit during the actual scan sequence (TEMPERATURE and MILLIVOLTS should not blink). SINGLE — Single scan should occur. Channel data will stop and remain at 10. INTERVAL — Repeated scan sequences with a 10 second time interval between the start of each scan. Display will read the date and time between scans. MONITOR — Continuously displays channel 5. CONTINUOUS — Continuously scans channel 0-10 with a minimum delay (<1 second) between the end of one scan sequence and the start of the next. REMOTE — Displays date and time, no scan sequence.		74	
74.	Do all scan sequences react normally?	76	75	
75.	Check the operation of each Mode switch and its associated driver on the Mode Switch PCB Assembly.			73
76.	Press the CONTINUOUS scan mode switch			77

Table 4-3. Troubleshooting (Continued)

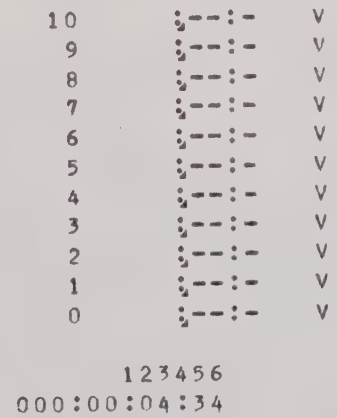
STEP NO.	INSTRUCTION	YES	NO	GO TO
77.	Momentarily press the PAPER ADVANCE switch in the OUTPUT CONTROL switch group.			78
78.	Does the scan sequence stop and remain at channel 10?	80	79	
79.	Defective Printer Drive PCB or Mode Switch PCB. Repair as required.			80
80.	Turn Power switch to POWER OFF then to POWER ON. Scan sequence will resume.			81
81.	Turn Power switch to POWER OFF.			82
82.	Connect Printer cable to Printer Drive PCB and set Power switch to ON.			83
83.	Does printer sound like it's running?	85	84	
84.	Check ±16V dc on Power Supply PCB. If voltage is okay, printer head is defective. Repair as required.			81
85.	Press PAPER ADVANCE switch.			86
86.	Does printer advance paper?	88	87	
87.	If scan sequence stops, printer head is defective. Interrupting power will resume scan sequence. Repair or replace printer head.			81
88.	Sequentially press the following switches: RESET (SCAN CONTROL) ALL DATA (PRINTER ENABLE) SINGLE (SCAN CONTROL) The printer should print:  			89
89.	Release the ALL DATA switch and press LIMIT DATA (PRINTER ENABLE).			90
90.	Does the printer print?	91	92	
91.	Note channels printed and verify that Limit A and B addresses for those channels are skipped.			67
92.	Release the LIMIT DATA switch, press INTERVAL DATA and then press CONTINUOUS (SCAN CONTROL). The printer should print data for channels 0 through 10 once during each interval period. In this case 10 seconds. The scan continues normally between intervals.			93
93.	Release the INTERVAL DATA switch. The scanning sequence should continue but data will not be printed.			94

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
94.	Does the printer respond normally to the PRINTER ENABLE switch settings?	96	95	
95.	Defective Mode Switch, Printer Drive PCB or Printer head. Repair as required.			88
	DISPLAY CONTROL TEST			
96.	Press FIRST CHANNEL in the SCAN FORMAT group, and then CHANNEL ENABLE in the PROGRAMMING group. The display should read: 00 4.0000 volts			97
97.	Press ALL CHANNELS in the DISPLAY CONTROL group. The continuous scan of channels (0 through 10) should be displayed.			98
98.	Press MONITOR CHANNEL in the DISPLAY CONTROL group. The CHANNEL display should read 005.			99
99.	Press DATE AND TIME in the DISPLAY CONTROL group. The time-of-day and date code should be displayed.			100
100.	Does the display respond normally to the DISPLAY CONTROL settings?	102	101	
101.	Defective Keyboard Switch PCB or Keyboard Memory PCB. Repair as required.			96
	PROGRAM LIST			
102.	Press RESET in the SCAN CONTROL group and ALL DATA in the PRINTER ENABLE group.			103
103.	Press PROGRAM LIST. The printer should record: Date and time, interval time, monitor channel, all available limits by address and their assigned values (may read any value at this point), all programmed channels (0-10) by address and their assigned function data. All channels should show the 4V function (4.0000V).			104
104.	Is program data listed properly?	106	105	
105.	Missing column data indicates defective printer head. If no list is printed PROGRAM LIST switch or Printer Drive PCB may be defective. Missing digits in LIMIT data only indicates that the limits need programming or the Keyboard Memory PCB is defective. If this is the case go to the next step. If printed data does not agree with displayed data, check the Printer Drive PCB.			102
	PROGRAMMING LIMITS			
106.	If the limits options (-21 or -22) are installed program each available limit (as indicated on the previously printed Program List) to <00000. Observe the display as each limit value is entered with the ENTER/STEP switch.			107
107.	Does entered data for one or more channels change when the ENTER/STEP switch is pressed?	108	109	

Table 4-3. Troubleshooting (Concluded)

<table>
<tr><th>STEP NO.</th><th>INSTRUCTION</th><th>YES</th><th>NO</th><th>GO TO</th></tr>
<tr><td>108.</td><td>One of the following IC's on the Keyboard Memory PCB is defective. Repair is required.
<table>
<tr><th>LIMIT ADDRESS</th><th>IC</th></tr>
<tr><td>1 through 3</td><td>U3</td></tr>
<tr><td>4 through 7</td><td>U4</td></tr>
<tr><td>8 through 11</td><td>U5</td></tr>
<tr><td>12 through 15</td><td>U12</td></tr>
<tr><td>16 through 18</td><td>U11</td></tr>
<tr><td>19 through 22</td><td>U8</td></tr>
<tr><td>23 through 26</td><td>U7</td></tr>
<tr><td>27 through 30</td><td>U6</td></tr>
</table></td><td></td><td></td><td>106</td></tr>
<tr><td>109.</td><td>Program channels 0 through 10 with the following function data, and review after entry.
<table>
<tr><th colspan="2">PROGRAM DATA</th><th colspan="2">REVIEW DATA</th></tr>
<tr><th>CHANNEL</th><th>FUNCTION</th><th>CHANNEL DISPLAY</th><th>DATA DISPLAY</th></tr>
<tr><td>0</td><td rowspan="4">T1 T2 T3 T4 Enter skip if temperature option is not installed.</td><td>000</td><td>1</td></tr>
<tr><td>1</td><td>001</td><td>2</td></tr>
<tr><td>2</td><td>002</td><td>3</td></tr>
<tr><td>3</td><td>003</td><td>4</td></tr>
<tr><td colspan="2">or s s s</td></tr>
<tr><td>4</td><td>40 mV</td><td>004</td><td>40.000 Millivolts</td></tr>
<tr><td>5</td><td>400 mV</td><td>005</td><td>400.00 Millivolts</td></tr>
<tr><td>6</td><td>HI LIMIT</td><td>006</td><td>40000</td></tr>
<tr><td>7</td><td>4V</td><td>007</td><td>4.0000 Volts</td></tr>
<tr><td>8</td><td>40V</td><td>008</td><td>40.000 Volts</td></tr>
<tr><td>9</td><td>SKIP</td><td>009</td><td>s s s</td></tr>
<tr><td>10</td><td>SKIP</td><td>010</td><td>s s s</td></tr>
</table></td><td></td><td></td><td></td></tr>
<tr><td>110.</td><td>Program data correctly entered and verified?</td><td>112</td><td>111</td><td></td></tr>
<tr><td>111.</td><td>Defective range and function memory. Repair as required.</td><td></td><td></td><td>109</td></tr>
<tr><td>112.</td><td>Turn Power switch to POWER OFF, install Guard Crossing PCB PCB and set the Power switch to POWER ON. Review channel data entered earlier in this procedure. The following results should be obtained for the units that display 2240 2 on initial turn on.
<table>
<tr><th>PROGRAM CHANNEL</th><th>CHANNEL DISPLAY</th><th>DATA DISPLAY</th></tr>
<tr><td>0</td><td>000</td><td>1</td></tr>
<tr><td>1</td><td>001</td><td>2</td></tr>
<tr><td>2</td><td>002</td><td>3</td></tr>
<tr><td>3</td><td>003</td><td>4</td></tr>
<tr><td colspan="2"></td><td>or s s s</td></tr>
<tr><td>4</td><td>*004</td><td>40.000 Millivolts (flashing)</td></tr>
<tr><td>5</td><td>005</td><td>400.00 Millivolts</td></tr>
<tr><td>6</td><td>*006</td><td>40000 (flashing)</td></tr>
<tr><td>7</td><td>007</td><td>4.0000 Volts</td></tr>
<tr><td>8</td><td>*008</td><td>40.000V (flashing)</td></tr>
<tr><td>9</td><td>009</td><td>s s s</td></tr>
<tr><td>10</td><td>010</td><td>s s s</td></tr>
</table></td><td></td><td></td><td>113</td></tr>
<tr><td>113.</td><td>Is reviewed channel data correct?</td><td>115</td><td>114</td><td></td></tr>
<tr><td>114.</td><td>Guard crossing defective. Repair as required.</td><td></td><td></td><td>109</td></tr>
<tr><td>115.</td><td>2240A Mainframe is operational.</td><td></td><td></td><td></td></tr>
</table>

**Those units that display 2240 1 on initial turn on will flash the channel number and have a blank data display.*

Section 5

Lists of Replaceable Parts

TABLE OF CONTENTS

REFERENCE DESIGNATOR	NAME	PART NO.	PAGE
	2240A Final Assembly		5-3
A1	Mother Board PCB Assembly	409425	5-8
A2	Power Supply PCB Assembly	409433/426676	5-9
A3	Controller PCB Assembly	499441	5-12
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A5	Printer Drive PCB Assembly	409482	5-16
A6	Display PCB Assembly	409656	5-18
A7	Mode Switch PCB Assembly	409664	5-20
A8	Keyborad Switch PCB Assembly	409672	5-21
A9	Keyboard Logic PCB Assembly	409680	5-22
A10	Keyboard Memory PCB Assembly	409698	5-24
A11	Range and Function Memory PCB Assembly	412445	5-25

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphanumerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number.

b. Description of each part.

c. Fluke Stock Number.

d. Federal Supply Code for Manufacturers.

e. Manufacturer's part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc, that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity, paragraph 5-7.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

a. Quantity

b. FLUKE Stock Number

c. Description

d. Reference Designation or Item Number

e. Printed Circuit Board Part Number

f. Instrument model and Serial number

5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY

CAUTION
Indicated devices are subject to damage by static discharge.

2240A FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY MODEL 2240A Figure 5-1.						
A1	Mother Board PCB Assembly, tested (2200A-4001T) Figure: 8-2	409425	89536	409425	1		
A2	Power Supply PCB Assembly (Standard) (2200A-4002T) Figure: 8-3	409433	89536	409433	1		
A2	Power Supply PCB Assembly (100V Model) (2200A-4018T) Figure: 8-3	426676	89536	426676	1		
A3	Controller PCB Assembly, tested (2200A-4003T) Figure: 8-4	409441	89536	409441	1		
A4	Guard Crossing PCB Assembly (Standard) tested (2200A-4004T) Figure: 8-12	409458	89536	409458	1		
A5	Printer Drive PCB Assembly, tested (2200A-4007T) Figure: 8-5	409482	89536	409482	1		
A6	Display PCB Assembly, tested (2240A-4008T) Figure 8-6	409656	89536	409656	1		
A7	Mode Switch PCB Assembly, tested (2240A-4009T) Figure 8-7	409664	89536	409664	1		
A8	Keyboard Switch PCB Assembly (2240A-4011T) Figure: 8-8	409672	89536	409672	1		
A9	Keyboard Logic PCB Assembly (2240A-4012T) Figure: 8-9	409680	89536	409680	1		
A10	Keyboard Memory PCB Assembly (2240A-4013T) Figure: 8-10	409698	89536	409698	1		
A11	Range and Function Memory PCB Assembly (2240A-4032T) Figure: 8-11	412445	89536	412445	1		
F1	Fuse, slo-acting, 3/4 A	109256	89536	109256	1		
F1	Fuse, slo-acting, 3/8 A (use with 230V/50 Hz)	109264	89536	109264	1		
S1	Switch, power (on keyboard bracket)	417204	89536	417204	1		
U3	IC, CMOS, ROM, control (located on Controller PCB) ⊗	429118	89536	429118	1		
U4	IC, CMOS, ROM, keyboard (located on Controller PCB) ⊗	429126	89536	429126	1		
XF1	Fuse Holder	424416	89536	424416	1		

2240A FINAL ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Y1	*Crystal, quartz, 2.4 MHz (use with 60 Hz line)	408153	89536	408153	1		
Y1	*Crystal, quartz, 2.0 MHz (use with 50 Hz line)	408161	89536	408161	1		
1	Bail, full width	231407	89536	231407	1		
2	Bracket, isothermal	411728	89536	411728	1		
3	Bracket, printer	412254	89536	412254	1		
4	Bracket, trim support	411694	89536	411694	1		
5	Bulkhead, unguarded	411678	89536	411678	1		
6	Bushing, nylon (for printer mechanism cable)	104620	28520	SB500-6	1		
7	Bushing, steel	375162	73734	32-201	4		
8	Cable assy	413344	32038	5132-010	5		
9	Cable assy	380576	32038	5122-003.5	1		
10	Cable assy	380568	32038	5112-003.25	1		
11	Card guide	256461	23880	1450F	17		
12	Chassis, left side	412239	89536	412239	1		
13	Chassis, right side	412247	89536	412247	1		
14	Corner, machined	423814	89536	423814	2		
15	Cover, bottom	412288	89536	412288	1		
16	Cover, guard chamber	411645	89536	411645	1		
17	Cover, rear	409623	89536	409623	1		
18	Cover, top	412270	89536	412270	1		
19	Cover, unguarded	411686	89536	411686	1		
20	Decal, corner	296277	89536	296277	4		
21	Decal, front panel	413922	89536	413922	1		
22	Decal, handle trim	295501	89536	295501	2		
23	Decal, nameplate	416917	89536	416917	1		
24	Decal, paper loading (inside paper tape drawer)	424119	89536	424119	1		
25	Decal, rear panel	419358	89536	419358	1		
	*Located on guard crossing PCB assembly.						

2240A FINAL ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
26	Decal, rear panel, caution	428201	89536	428201	1		
27	Decal, side trim	295402	89536	295402	2		
28	Display lens	414334	89536	414434	1		
29	Drawer	412346	89536	412346	1		
29	Drawer, front	390823	89536	390823	1		
30	Foot, bail stand	292870	89536	292870	4		
31	Guard, bracket	411736	89536	411736	1		
32	Guard, chamber	411611	89536	411611	1		
33	Handle	423053	89536	423053	2		
36	Lock, key operated	417543	89536	417543	1		
37	Panel, front	411744	89536	411744	1		
38	Panel, rear	412221	89536	412221	1		
39	Printer access door	357681	89536	357681	1		
40	Printer head	355446	54124	102	1		
	Bushing, nylon (located on bottom of printer paper drawer)	102988	28520	SB250-2	4		
	Card guide (printer-paper drawer slides)	229047	23880	1800F	2		
	Card guide (short guides located on Mother Board)	298836	89536	298836	21		
	Clamp, printer cable	165951	31827	3-4-1	1		
	Grommet, printer, rubber	135269	83330	135269	4		
	Guard, plane (located on bottom of Mother Board)	411637	89536	411637	1		
	Line cord	343723	89536	343723	1		
	Paper tape (located in printer paper drawer)	362962	89536	362962	1		
	Paper Tray Assy	414904	89536	414904	1		
	Printer cutter bar (located on printer head)	423954	54124	1425120	1		
✱	Ribbon, typewriter (located on printer head)	364117	89536	364117	1		
	Power switch cable (connects to power supply)	374009	89536	374009	1		
	Power cable (from rear panel line cord connector)	398115	89536	398115	1		
	Power switch cable (connects to power cable)	419952	89536	419952	1		

A1 MOTHER BOARD PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	**MOTHER BOARD PCB ASSEMBLY (2200A-4001T) Figure 8-2**	409425	89536	409425	REF		
C1, C3, C4	Cap, cer, 20,000 pF ± 20%	407403	72982	811-000-Z5U0203M	3		
J1, J3, J5, J7, J9	Socket, 14-pin, DIP	387316	71785	133-59-02-059	5		
J11	Conn, 12-pin	291898	00779	583650-2	6		
J12, J24	Conn, 6-pin	291625	00779	583650-1	7		
J23, J26, J27, J28, J32, J34	Conn, 36-pin	404947	00779	1-583407-8	6		
J25, J31	Conn, 16-pin	408484	00779	583407-9	2		
	Key, connector, polorizing	424572	00779	530286-2	25		

A2 POWER SUPPLY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	**POWER SUPPLY PCB ASSEMBLY (STANDARD) (2200A-4002T) Figure 8-3**	409433	89536	409433	REF		
A2	**POWER SUPPLY PCB ASSEMBLY (100V) (2200A-4018T) Figure 8-3**	426676	89536	426676	REF		
C1, C2	Cap, elect, 100 μF -10/+50%, 40V	236919	73445	ET101X040A6	2	1	
C3	Cap, elect, 8000 μF -10/+100%, 15V	309245	12676	61C15AS83	1	1	
C4, C6, C9, C11	Cap, Ta, 10 μF $\pm$ 20%, 20V	330662	56289	196D106X-0020KA1	4		
C5	Cap, elect, 15,000 μF -10/+75%, 15V	310367	06001	86F520	1	1	
C7	Cap, Ta, 1 μF $\pm$ 20%, 35V	161919	56289	196D105X-0020JA1	1		
C8, C14, C16	Cap, cer, 50,000 pF $\pm$ 20%, 100V	149161	56289	55C23A1	3		
C10	Cap, elect, 8000 μF -10/+100%, 25V	309971	12954	39C025SL83	1	1	
C12	Cap, Ta, 4.7 μF $\pm$ 20%, 25V	161943	56289	196D475X-0025KA1	1		
C13	Cap, cer, 2000 pF GMV, 1 kV	105569	71590	DA140-139CB	1		
C15	Cap, elect, 2100 μF -10/+100%, 35V	370742	12954	33C35JJ212	1	1	
CR1, CR2 CR10	Diode bridge	296509	09423	FB200	3	1	
CR3, CR4, CR5, CR6	Diode, Si, high voltage	325746	04713	MR751	4	1	
CR11, CR12, CR14, CR15, CR16	Diode, Si, low power	203323	07910	1N4448	5	1	
J48	Connector, 3-pin Pin, connector	417154 342998	27264 27264	03-09-2032 02-09-2133	1 3		
Q1	Xstr, Si, NPN	418095	95303	2N6383	1	1	
Q2, Q4, Q5, Q10	Xstr, Si, NPN	218396	04713	2N3904	4	1	

A2 POWER SUPPLY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q3	Xstr, Si, NPN	386128	01295	T1P120	1	1	
Q6, Q7, Q11	Xstr, Si, PNP	195974	04713	2N3906	3	1	
Q8	Xstr, Si, NPN	325720	04713	MJE3055	1	1	
Q9	Xstr, FET, N-chan	261578	07910	U2366E	1	1	
R1	Res, comp, 2K ± 5%, ¼W	202879	01121	CB2025	1		
R2	Res, mf, 953 ± 1%, 1/8W	288555	91637	MFF1-89530F	1		
R3	Res, mf, 2.37K ± 1%, 1/8W	293720	91637	MFF1-82371F	1		
R4, R6	Res, comp, 47K ± 5%, ¼W	148163	01121	CB4735	2		
R5, R23	Res, comp, 1K ± 5%, ¼W	148023	01121	CB1025	2		
R7	Res, comp, 510 ± 5%, ¼W	218032	01121	CB5115	1		
R9	Res, ww, 0.62 ± 5%, 2W	219352	75042	BWHR62J	1	1	
R10	Res, comp, 2.7K ± 5%, ¼W	170720	01121	CB2725	1		
R11	Res, mf, 7.50K ± 1%, 1/8W	223529	91637	MFF1-87501F	1		
R12	Res, comp, 15K ± 5%, ¼W	148114	01121	CB1535	1		
R13, R26, R27	Res, mf, 10K ± 1%, 1/8W	168260	91637	MFF1-81002F	3		
R14	Res, mf, 1.15K ± 1%, 1/8W	293597	91637	MFF1-81151F	1		
R15	Res, comp, 2.4K ± 5%, ¼W	193443	01121	CB2425	1		
R16	Res, comp, 100 ± 10%, ¼W	193185	01121	CB1011	1		
R17	Res, var, 50 ± 10%, ½W	291120	71450	360S103A	1	1	
R18	Res, comp, 5.1K ± 5%, ¼W	193342	01121	CB5125	1		
R19, R28	Res, comp, 100K ± 5%, ¼W	148189	01121	CB1045	2		
R20, R22	Res, ww, 1.2 ± 5%, 2W	248658	75042	BWH1R2J	2	1	
R21	Res, comp, 330 ± 5%, ¼W	147967	01121	CB3315	1		
R24	Res, mf, 5.11K ± 1%, 1/8W	294868	91637	MFF1-85111F	1		
R25	Res, comp, 22M ± 10%, 2W	108233	01121	EB2261	1		
S1	Switch, slide, DPDT	234278	82389	XW1649	1	1	
S2	Switch, slide SPDT	386813	C.W. Inds	GS-111-SPDT	1	1	

A2 POWER SUPPLY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
T1	Xfmr, power (Standard)	409979	89536	409979	1		
T1	Xfmr, power (100V)	427765	89536	427765	1		
U1	IC, CMOS, hex buffer ⊗	381830	04713	MC14050CP	1	1	
U2	IC, lin, opnl ampl	310219	12040	LM304H	1	1	
U3	IC, CMOS, time base generator ⊗	404251	04713	MC14566CP	1	1	
VR1	IC Lin, volt, reg	355107	07263	F7805UC	1	1	
VR2	Diode, zener	277236	07910	1N752A	1	1	
1	Heat sink	411710	89536	411710	1	1	
2	Heat sink	386235	13103	6032D	2		
3	Heat sink	374934	89536	374934	1		
4	Socket, IC, 16-pin	276535	91506	316AG39D	2		
	Nameplate (100V only)	433862	89536	433862	1		

A3 CONTROLLER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	**CONTROLLER PCB ASSEMBLY (2200A-4003) Figure 8-4.**	404491	89536	404491	REF		
C1, C3 C4	Cap, cer, 10,000 pF -20/+80%, 25V	335786	72982	5835-000Y5-U103Z	3		
C2	Cap, mica, 51 pF ± 5%, 500V	277210	72136	DM15E510J	1		
C5, C6	Cap, Ta, 2.2 µF, ± 20%, 15V	364216	56289	196D222X-0015HA1	2		
C7, C8	Cap, Ta, 10 µF ± 20%, 15V	193623	56289	196D100X-0015KA1	2		
C9, C10	Cap, cer, 0.025 µF ± 20%, 100V	168435	56289	C023B101-H253M	2		
Q1, Q4	Xstr, Si, NPN	218081	04713	MPS6520	2	1	
Q2	Xstr, Si, PNP	229898	04713	MPS6522	1	1	
Q3	Xstr, Si, NPN	159855	07910	CS23030	1	1	
R1, R2	Res, comp, 820 ± 5%, ¼W	148015	01121	CB8215	2		
R3, R15, R19, R21, R22, R24	Res, comp, 1K ± 5%, ¼W	343426	01121	CB1025	6		
R4, R5	Res, comp, 5.6K ± 5%, ¼W	148080	01121	CB5625	2		
R6, R7 R18, R23	Res, comp, 110 ± 5%, ¼W	193474	01121	CB1115	4		
R8, R10, R11, R12	Res, comp, 470 ± 5%, ¼W	343434	01121	CB4715	4		
R9, R13, R16, R17	Res, comp, 10K ± 5%, ¼W	348839	01121	CB1035	4		
R14	Res, comp, 2.7K ± 5%, ¼W	386490	01121	CB2725	1		
R20	Res, comp, 100K ± 5%, ¼W	348920	01121	CB1045	1		
S1 thru S4	Switch Assembly, 4-spst	408559	00779	435166-2	4	1	
U1	IC, TTL, hex inverter	418004	01295	SN74S04N	1	1	
U2	IC, CMOS, clock driver ⊗	408567	12040	MH0026CN	1	1	
U7	IC, TTL, quad 2-input NAND gate	363580	01295	SN74S00N	1	1	

A3 CONTROLLER PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U8	IC, TTL, counter	340463	01295	SN74163N	1	1	
U9	IC, CMOS, 4-bit cpu ⊗	404418	34649	C4040	1	1	
U10	IC, CMOS, standard memory interface ⊗	404434	34649	P4289	1	1	
U13	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	1	1	
U14	Res network	387100	89536	387100	1	1	
U15	IC, TTL, 1-of-10 decoder	393009	01295	SN74L42N	1	1	
U17	Res network	358119	89536	358119	1	1	
U18	IC, CMOS, dual J-K flip-flop ⊗	355230	04713	MC14027CP	1	1	
U19	IC, PMOS, 320-bit RAM, 4-bit output ⊗	404467	34649	P4002-2	1	1	
U20, U21	IC, PMOS, 320-bit RAM, 4-bit output ⊗	404442	34649	P4002-1	2	1	
U22, U23	IC, TTL, hex inverter, open collector	394536	01295	SN74LS05	2	1	
U24	IC, CMOS, triple 3-input NOR gate ⊗	355180	04713	MC14025CP	1	1	
U25	Res network	364000	89536	364000	1	1	
U26	IC, COS/MOS, hex buffer/converter ⊗	381848	95303	CD4049AE	1	1	
U27	IC, CMOS, hex buffer ⊗	407759	12040	MM80C97N	1	1	
U28	Res, network	376962	89536	376962	1	1	
U29	IC, CMOS, dual 4-input NAND gate ⊗	355206	04713	MC14012CP	1	1	
Y1	Crystal, 5.185 MHz	408518	89536	408518	1	1	
	Socket, IC, 24-pin (use with U9)	418970	91506	324-AG39D	6		
	Socket, IC, 40-pin (use with U10)	418988	91506	340-AG39D	1		
	Socket, IC, 16-pin (use with U19, U20, U21)	276535	91506	316-AG39D	5		

A4 GUARD CROSSING PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	**GUARD CROSSING PCB ASSEMBLY (2200A-4004T) Figure 8-12**	409458	89536	409458	REF		
C1 thru C7, C9, C10, C11, C13	Cap, cer, 5000 pF ± 20%, 100V	175232	56289	C023B101-E502M	11		
C8	Cap, cer, 100 pF ± 10%, 1 KV	105593	71590	DD101	1		
C12, C14	Cap, Ta, 10 μF ± 20%, 35V	330662	56289	196D106X-0035KA1	2		
C20, C21	Cap, Ta, 0.22 μF ± 20%, 35V	161331	56289	196D224X-0035HA1	2		
01 thru 023	Xstr, Si, NPN	218396	04713	2N3904	23	5	
R1, R7, R8, R11, R14	Res, comp, 1K ± 5%, ¼W	148023	01121	CB1025	5		
R2 thru R5	Res, comp, 3K ± 5%, ¼W	193508	01121	CB3025	4		
R6, R9, R10	Res, comp, 330 ± 5%, ¼W	147967	01121	CB3315	3		
R12, R13	Res, comp, 2.2K ± 5%, ¼W	148049	01121	CB2225	2		
R15, R16	Res, comp, 150 ± 5%, ¼W	147934	01121	CB1515	2		
R20	Res, comp, 22K ± 5%, ¼W	348870	01121	CB2235	1		
R21	Res, mf, 100K ± 1%, 1/8W	248807	91637	MFF1-81003F	1		
R22	Res, comp, 200K ± 5%, ¼W	248781	01121	CB2045	1		
U1, U10, U14,U18, U20, U35	IC, TTL, triple 3-input positive NAND gate	393157	01295	SN74LS107N	6	2	
U2	IC, TTL, quad 2-input positive AND gate	393066	01295	SN74LS08N	1	1	
U3	IC, TTL, quad D-type flip-flop	408203	12040	DM85L51N	1	1	
U4 thru U7	IC, TTL, BCD counter with latch	408195	12040	DM85L52N	4	1	
U8	IC, COS/MOS, quad bilateral switch	363838	95303	CD4016AE	1	1	

A4 GUARD CROSSING PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U9, U32, U37, U39, U40	Opto-Isolator	387076	50579	ILD74	5	1	
U11	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	1	1	
U12, U27	IC, TTL, triple 3-input NAND gate	393074	01295	SN74LS10N	2	1	
U13	IC, TTL, quad 2-input exclusive -OR gate	408237	01295	SN74LS86N	1	1	
U15, U30, U50	IC, COS/MOS, hex buffer/converter ⊗	381848	95303	CD4049AE	3	1	
U16	IC, CMOS, dual 4-bit static shift register ⊗	340125	04713	MC14015CP	1	1	
U17, U24, U43, U46, U47	IC, CMOS, dual D-type flip-flop ⊗	340117	04713	MC14013L	5	1	
U19, U29	IC, TTL, dual D-type flip-flop	393124	01295	SN74LS74N	2	1	
U21	IC, TTL, triple 3-input NOR gate	393090	01295	SN74LS27N	1	1	
U22, U25	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02N	2	1	
U23, U26	IC, TTL, hex inverter	393058	01295	SN74LS04N	2	1	
U28	IC, TTL, dual one-shot	404186	01295	SN74LS123LN	1	1	
U31, U44	Res, network	408310	89536	408310	2	1	
U33, U41	Res, network	408302	89536	408302	2	1	
U34	IC, TTL, decade counter	402545	01295	SN74LS90N	1	1	
U36, U52	Res, network	408294	89536	408294	2	1	
U38	Opto-Isolator	380014	50522	MCT2	1	1	
U42, U49	IC, COS/MOS, quad 2-input NOR gate ⊗	355172	95303	CD4001AC	2	1	
U45	IC, CMOS, strobed hex inverter ⊗	408211	04713	MC14502CP	1	1	
	Socket Crystal	148668	91506	8000-AG10	1	1	

A5 PRINTER DRIVE PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	PRINTER DRIVE PCB ASSEMBLY (2200A-4007) Figure 8-5	409482	89536	409482	REF		
C1, C2, C3, C4, C6, C9	Cap, cer, 50,000 pF ± 20%, 100V	149161	56289	55C23A1	6		
C5, C8	Cap, cer, 10,000 pF ± 20%, 100V	149153	56289	C023B101F-103M	2		
C7	Cap, elect, 330 μF -10/+50%, 16V	187765	73445	ET331X016-A02	1	1	
C10 thru C14	Cap, cer, 25,000 pF ± 20%, 100V	168435	56289	C023B101H-253M	4		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 5.1K ± 5%, ¼W	193342	01121	CB5125	1		
R2, R3 R4, R7	Res, comp, 1K ± 5%, ¼W	148023	01121	CB1025	2		
R5, R8	Res, comp, 12K ± 5%, ¼W	159731	01121	CB1235	2		
R6, R9	Res, comp, 2K ± 5%, ¼W	202879	01121	CB2025	2		
U1, U26	IC, TTL, hex inverter	393058	01295	SN74LS04N	2	1	
U2, U5, U7, U18	IC, TTL, dual D-type flip-flop	393124	01295	SN74LS74N	2	1	
U3	IC, TTL, dual J-K flip-flop	414029	01295	SN74LS112N	1	1	
U4	IC, TTL, triple 3-input NOR gate	393090	01295	SN74LS27N	1	1	
U6	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02N	1	1	
U8, U9	IC, TTL, 8-bit parallel out serial shift register	408732	01295	SN74LS164N	2	1	
U10	IC, COS/MOS, hex buffer ⊗	355412	95303	CD4010AE	1	1	
U11	IC, COS/MOS, hex inverter ⊗	355214	95303	CD4009AE	1	1	
U12	IC, TTL, triple 3-input NAND gate	393074	01295	SN74LS10N	1	1	
U13	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	1	1	
U14 thru U17, U20 thru U24	IC, TTL, dual peripheral NAND driver	329706	01295	SN75452P	9	2	
U19, U27	IC, Lin, Comparator	352195	01295	SN72311P	2	1	
U25	IC, CMOS, hex tri-state buffer ⊗	407759	04713	MC14503CP	1	1	

A5 PRINTER DRIVE PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Pin, contact	424135	27264	09-64-1152	1		
	Socket, IC, 14-pin	387316	71785	133-59-02-059	2		

A6 DISPLAY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	**DISPLAY PCB ASSEMBLY (2240A-4008T) Figure 8-6**	409656	89536	409656	REF		
C3	Cap, cer, 100 pF ± 10%, 1 KV	105593	71590	DD-101	1		
C4	Cap, Ta, 39 μF ± 20%, 6V	163915	56287	196D396X-0006KA1	1		
C5	Cap, elect, Ta, 33 μF ± 10%, 10V	182832	56289	150D336X-9010B2	1	1	
CR1, CR2, CR3, CR7, CR17	Diode, Si, switching	313247	28480	HP5082-6264	5	1	
CR4, CR5, CR6, CR8 thru CR16	Diode, Si, switching	203323	07910	1N4448	12	3	
CR18, CR19, CR20, CR21	Diode, light-emitting	428623	12040	59NSL-5046	4	1	
DS1 thru DS9	LED, display, 7-segment	418012	28480	5082-7651	9	2	
J43	Socket, IC, 14-pin	387316	71785	133-59-02-059	1		
Q1, Q2, Q3, Q5 thru Q11	Xstr, Si, PNP	352369	12040	2N4403	10	2	
R1, R2, R5, R7, R25	Res, comp, 68 ± 5%, ¼W	414532	01121	CB6805	5		
R3	Res, comp, 6.8k ± 5%, ¼W	368761	01121	CB6825	1		
R11, R13, R17, R19, R23	Res, comp, 51 ± 5%, ¼W	414540	01121	CB5105	5		
R29	Res, comp, 33 ± 5%, ¼W	414524	01121	CB3305	1		
U1, U4	IC, TTL, BCD-to-7-segment decoder/driver	340109	01295	SN7447AN	2	1	
U2, U5	Res, network	344069	89536	344069	2	1	
U3, U6, U8	IC, TTL, BCD-to-decimal decoder/driver	293175	01295	SN74145N	3	1	
U7	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02N	1	1	
U9	Res, network	364018	89536	364018	1	1	

A6 DISPLAY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U10, U11	Res, network	414557	89536	414557	2	1	
	Socket, display LED	276527	91506	314-AG39D	9		
	Socket, annunciator LED	436055	22526	65358-001	4		

A7 MODE SWITCH PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	**MODE SWITCH PCB ASSEMBLY (2240A-4009T) Figure 8-7**	409664	89536	409664	REF		
C1	Cap, Ta, 22 μF $\pm$ 20%, 25V	357780	56289	196D220X-0025PE4	1		
C2	Cap, film, 0.0047 μF $\pm$ 10%, 100V	106054	56289	192P47202	1		
J41	Conn, PCB	414375	27264	09-52-3151	1		
J42	Socket, 14-pin	387316	71785	133-59-02-059	1		
R1	Res, carbon film, 47k $\pm$ 5%, ¼W	348896	80031	CR251-45P47-KTS	1		
U1	IC, TTL, synchronous 4-bit binary up/down counter	393231	01295	SN74LS193N	1	1	
U2	IC, CMOS, dual J-K flip-flop ⊗	355230	04713	MC14027CP	1	1	
U3, U8, U13	IC, COS/MOS, hex, inverter ⊗	381848	86684	CD4050AE	3	1	
U4	IC, TTL, one-shot mv	293134	04713	MC9601P	1	1	
U5	IC, TTL, 64-bit (4 x 16) read/write memory	408583	01295	SN7489N	1	1	
U6, U10	Res, network	352054	89536	352054	2	1	
U7	IC, CMOS, dual 4-input NOR gate ⊗	363820	04713	MC14002CP	1	1	
U9	IC, COS/MOS, triple 3-input OR gate ⊗	408575	86684	CD4075BE	1	1	
U11	IC, TTL, dual J-K flip-flop	393157	01295	SN74LS107N	1	1	
U12, U19	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	2	1	
U14, U17	IC, COS/MOS, hex buffer/converter ⊗	381830	86684	CD4049AE	2	1	
U15, U16	IC, CMOS, hex tri-state buffer ⊗	407759	04713	MC14503CP	2	1	
U18	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	1	1	
U20	Res, network	408310	89536	408310	1	1	
1	Pushbutton, switch	412163	89536	412163	13		
2	Switch assembly	408526	89536	408526	1	1	
	Spacer, switch-to-pcb	295246	71590	J64286	11		

A8 KEYBOARD SWITCH PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A8	**KEYBOARD SWITCH PCB ASSEMBLY (2240A-4011T) Figure 8-8**	409672	89536	409672	REF		
C1	Cap, plstc, 0.1 μF $\pm$ 20%, 250V	161992	89536	161992	1		
CR1, CR3 thru CR13	Diode, light-emitting	428623	12040	59NSL-5046	12	3	
P44, P45	Pin, contact	380683	27264	09-64-1121	2		
Q1	Xstr, Si, PNP	203364	07263	S37234	1	1	
R1, R2, R3	Res, comp 12k $\pm$ 5%, ¼W	159731	01121	CB1235	3		
R4, R6 thru R12	Res, comp, 100 $\pm$ 5%, ¼W	147926	01121	CB1015	8		
R5	Res, comp, 680 $\pm$ 5%, ¼W	148007	01121	CB6815	1		
R13	Res, comp, 8.2k $\pm$ 5%, ¼W	160796	01121	CB8225	1		
R14	Res, comp, 10m $\pm$ 5%, ¼W	194944	01121	CB1065	1		
R15	Res, comp, 2.4m $\pm$ 5%, ¼W	221945	01121	CB2455	1		
U1	IC, TTL, 4-to-16 line decoder	408351	12040	MM74C154N	1	1	
U2, U3	IC, TTL, hex inverter, with open-collector outputs	288605	01295	SN7416N	2	1	
U4	IC, CMOS, triple 3-input NOR gate ⊗	355172	04713	MC14025CP	1	1	
1	Pushbutton, blue	406876	89536	406876	1		
2	Pushbutton, grey	406819	89536	406819	17		
3	Pushbutton, orange	420620	89536	420620	1		
4	Pushbutton, white	406884	89536	406884	11		
5	Actuator, switch	412106	89536	412106	30		
6	Contact, switch	416875	00779	62380-4 & 62313-4	30		
7	Contact spring, switch	414516	00779	62353-3 & 62312-3	30		
8	Cover, switch	401299	89536	401299	30		
9	Spacer, swaged	380352	89536	380352	7		
10	Socket, 2-contact	436055	22526	65358-001	12		

A9 KEYBOARD LOGIC PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A9	**KEYBOARD LOGIC PCB ASSEMBLY (2240A-4012T) Figure 8-9**	409680	89536	409680	REF		
C1	Cap, film, 0.22 µF ± 10%, 50V	271577	06001	75F1R5A223	1		
C2, C5	Cap, Ta, 10 µF ± 20%, 10V	176214	56289	196D106X-0010KA1	2		
C3	Cap, Ta, 2.2 µF ± 10%, 15V	364216	56289	196D222X-9015HA1	1		
C4	Cap, cer, 1000 pF ± 10%, 500V	357806	71590	CF-102	1		
C6	Cap, cer, 100 pF ± 10%, 1 kV	105593	71590	DD-101	1		
J35	Socket, IC, 16-pin	276535	91506	316AG39D	1		
J44, J45	Connector, female, 12-pin	380691	27264	09-52-3122	2		
J49	Conn, post	379438	00779	86144-5	2		
LS1	Speaker	339879	72653	TYPE S2-203	1		
Q1, Q2	Xstr, Si, PNP	203364	07263	S37234	2	1	
Q3, Q4	Xstr, Si, NPN	218396	04713	2N3904	2	1	
Q5	Xstr, Si, NPN	381798	04713	MPSA-13	1	1	
R1, R2, R4, R14	Res, comp, 680 ± 5%, ¼W	148007	01121	CB6815	4		
R3	Res, comp, 1M ± 5%, ¼W	182204	01121	CB1055	1		
R5	Res, comp, 62 ± 5%, ¼W	261842	01121	CB6205	1		
R6	Res, comp, 39 ± 5%, ¼W	193391	01121	CB3905	1		
R7	Res, comp, 47k ± 5%, ¼W	148163	01121	CB4735	1		
R8	Res, comp, 16k ± 5%, ¼W	221606	01121	CB1635	1		
R9	Res, comp, 150k ± 5%, ¼W	182212	01121	CB1545	1		
R10	Res, comp, 100k ± 5%, ¼W	148189	01121	CB1045	1		
R11	Res, comp, 200k ± 5%, ¼W	248781	01121	CB2045	1		
R13, R15, R16, R17	Res, comp, 8.2k ± 5%, ¼W	160796	01121	CB8225	4		
U1, U14	IC, COS/MOS, hex inverter ⊗	381848	86684	CD4049AE	2	1	
U2	IC, COS/MOS, quad 2-input OR gate ⊗	408393	86684	CD4071BE	1	1	

A9 KEYBOARD LOGIC PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U3	IC, CMOS, dual binary to 1-of-4 decoder ⊗	408369	04713	MC14556CP	1	1	
U4	IC, COS/MOS, quad 2-input AND gate ⊗	408401	86684	CD4081BE	1	1	
U5, U12, U16	IC, CMOS, dual D-type flip-flop ⊗	340117	12040	MM5613AN	3	1	
U6, U7	IC, CMOS, hex buffer ⊗	407759	12040	MM80C97N	2	1	
U8, U9, U15	IC, TTL, 4-bit bistable latch	408377	01295	SN74LS75N	3	1	
U10	IC, COS/MOS, quad 2-input NOR gate ⊗	355172	86684	CD4001AE	1	1	
U11	IC, COS/MOS, dual complementary pair plus inverter ⊗	408013	86684	CD4007AE	1	1	
U13	IC, COS/MOS, triple 3-input NAND gate ⊗	375147	86684	CD4023AE	1	1	
U17	IC, TTL, one-shot mv	404186	01295	SN74LS123N	1	1	
1	Bracket, speaker	415224	89536	415224	1		

A10 KEYBOARD MEMORY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	KEYBOARD MEMORY PCB ASSEMBLY (2240A-4013T) Figure 8-10	409698	89536	409698	REF		
BT1	Battery, lithium, 5.8V, 1 amp	408286	89536	408286	1	1	
C1	Cap, Ta, 10 μF ± 20%, 15V	193623	56289	196D106X-0015KA1	1		
C2	Cap, cer, 50,000 pF ± 20%, 100V	149161	56289	55C23A1	1		
CR1	Diode, Si switching	203323	07910	1N4448	1	1	
J2, J8, J10	Socket, IC, 14-pin	387316	71785	133-59-02-059	3		
J36	Socket, IC, 16-pin	276535	91506	316AG39D	1		
Q1, Q2	Xstr, Si, NPN	218081	04713	MPS6520	2	1	
Q3	Xstr, FET, N-channel	370072	89536	370072	1	1	
R1, R2, R4 thru R18, R26, R27	Res, comp, 6.8k ± 5%, ¼W	148098	01121	CB6825	19		
R3, R24	Res, comp, 15k ± 5%, ¼W	148114	01121	CB1535	2		
R19, R20, R21, R22, R28	Res, comp, 47k ± 5%, ¼W	148163	01121	CB4735	5		
R23	Res, comp, 30k ± 5%, ¼W	193417	01121	CB3035	1		
R25	Res, comp, 1k ± 5%, ¼W	108597	01121	CB1025	1		
S21	Switch, slide, SPDT	386813	79727	GS-111-SPDT	1		
U1, U2	IC, CMOS, 16 x 4 RAM ⊗	408385	12040	MM74C89N	2	1	
U9, U14, U15	IC, CMOS, tri-state hex buffer ⊗	407759	12040	MM80C97N	3	1	
U10	IC, CMOS, bcd to decimal decoder ⊗	407981	12040	MM74C42N	1	1	
U13	IC, COS/MOS, hex inverter ⊗	381848	86684	CD4049AE	1	1	
1	Strap, rubber	104794	98159	2829-115-3	2		

A11 RANGE AND FUNCTION MEMORY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	RANGE AND FUNCTION MEMORY PCB ASSEMBLY (2240A-4032T) Figure 8-11	412445	89536	412445	REF		
BT1	Battery, lithium, 5.8V, 1 amp	408286	89536	408286	1	1	
C1	Cap, elect 10 μF -10/+50%, 25V	170266	73445	ET100X025A2	1	1	
C2	Cap, Ta, 10 μF $\pm$ 20%, 20V	330662	56289	196D106X-0020KA1	1		
C3, C4	Cap, mica, 56 pF $\pm$ 5%, 500V	148528	72136	DM15F560J	2		
C5	Cap, cer, 0.1 μF $\pm$ 20%, 100V	149146	56289	33C41B6	1		
CR1, CR2	Diode, Si, switching	203323	07910	1N4448	2	1	
Q1 thru Q18	Xstr, Si, NPN	218396	04713	2N3904	18	4	
R1	Res, comp, 200 $\pm$ 5%, ¼W	193482	01121	CB2015	1		
R2, R3	Res, mf, 20k $\pm$ 1%, 1/8W	291872	91637	MFF1-82002F	2		
R4 thru R11	Res, comp, 10k $\pm$ 5%, ¼W	148106	01121	CB1035	8		
R12	Res, comp, 1k $\pm$ 5%, ¼W	148023	01121	CB1025	1		
S1	Switch, slide, SPDT	386813	79727	GS-111-SPDT	1	1	
U1, U2	Res, network	364000	89536	364000	2	1	
U3	Res, network	355305	89536	355305	1	1	
U4, U5, U9, U23, U24	IC, CMOS, hex inverters ⊗	355214	04713	MC14009CP	5	1	
U8, U15, U25	IC, COS/MOS, triple 3-input NAND gate ⊗	375147	86684	CD4023AE	3	1	
U16	IC, CMOS, triple 3-input NOR gate ⊗	355180	04713	MC14025CP	1	1	
U20	IC, COS/MOS, 4-stage parallel in/out shift register ⊗	414078	86684	CD4035AE	1	1	
U21	IC, CMOS, tri-state hex buffer ⊗	407759	12040	MM80C97N	1	1	
U22, U31	IC, CMOS, quad 2-input NAND gate ⊗	355198	04713	MC14011CP	2	1	
U26, U36, U37	IC, CMOS, dual J-K flip-flop ⊗	355230	04713	MC14027CP	3	1	

A11 RANGE AND FUNCTION MEMORY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U27, U28, U30, U34, U35, U38	IC, CMOS, dual D-type flip-flop ⊗	340117	12040	MM5613AN	6	2	
U29	IC, CMOS, hex buffers ⊗	355412	04713	MC14010CP	1	1	
U32	IC, CMOS, dual 4-input NOR gate ⊗	363820	04713	MC14002CP	1	1	
U33	IC, CMOS, dual 4-input NAND gate ⊗	355206	04713	MC14012CP	1	1	
U39, U40	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	2	1	
VR1	Diode, zener	340695	12969	UZ8710	1	1	
XU10 thru XU12, XU17 thru XU19, XU29	Socket, IC, 16-pin	276535	91506	316AG39D	7		
	Strap, rubber	104794	98159	2829-115-3	2		

Section 6
Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 2240A. It consists of an introductory section, an accessories subsection and a series of option subsections. All options and accessories are listed by model or option number in the table of contents. Corresponding subsection page numbers and other documentation location information are also listed.

6-3. Hardware type accessories, i.e., rack mounting kits and cables, are documented in the accessories subsection. However, the more complex accessories, (scanner chassis) are documented in stand-alone manuals which are provided with the purchased instrument.

6-4. The most commonly used options are documented herein as individual subsections. Each subsection contains all of the information necessary to install, operate, and maintain the option. This includes a list of replaceable parts and a schematic.

6-5. The less commonly used options are also documented as subsections. However, their documentation is supplied with the purchased option, and is added to Section 6 of this manual.

6-6. The location of a particular subsection is facilitated by the use of unique page and paragraph numbering which corresponds to the option or accessory in question. For example, a 600-x series identifies the general accessories subsection and a 605-x series identifies the subsection for the —05 option (where x is the sequential page or paragraph numbers).

TABLE OF CONTENTS

OPTION/ MODEL NO.	DESCRIPTION	DOCUMENTATION SUPPLIED:	PAGE NO.
	ACCESSORIES		
MO7-205-600	Rack Mounting Kit	Herein	600-1
MOO-280-610	Rack Slide Kit	Herein	600-1
2200A-7005	Service Extender Cable Set	Herein	600-1
2200A-7006	General Purpose Interface Cable (6-foot)	Herein	600-1
2200A-7007	Interface Connector, Blank (50-pin)	Herein	600-2
2201A	Scanner Chassis	With 2201A	
2202A	Remote Scanner Chassis	With 2202A	
2203A	RTD Scanner Chassis	With 2203A	
	OPTIONS		
—01	Not Used	—	
—02	Not Used	—	
—03	RTD Connector	With 2203A	
—04	RTD Scanner	With 2203A	
—05	General Purpose Scanner	Herein	605-1
—06	Low Level Scanner	Herein	606-1
—07	Solder Pin Connector	Herein	607-1
—08	Isothermal Block Connector	Herein	608-1
—09	A/D Converter, General Purpose	Herein	609-1
—10	A/D Converter, High Performance	Herein	610-1
—11	Temperature Measurement and Scaling	Herein	611-1
—12 Series	TTY/RS-232C Interface	With Option	612-1
—13 Series	Paper Tape Punch Interface	With Option	613-1
—14 Series	Magnetic Tape Interface	With Option	614-1
—15	Not Used	—	
—16	Digital Input Interface	With Option	616-1
—17	Not Used	—	
—18	Not Used	—	
—19	Not Used	—	
—20	Program Memory Expander	With Option	620-1
—21	Alarm Set, 7 Single Limits	With Option	621-1
—22	Alarm Set, 15 Single Limits	With Option	622-1
—23	Alarm Set-Point Output	With Option	623-1
—24	Not Used	—	
—25	Custom Scaling	With Option	625-1
—26	Multiple Custom Scaling	With Option	626-1
—27	Engineering Units	With Options	627-1
—28	Current Transmitter, 1-5 mA	With Options	628-1
—29	Current Transmitter, 0-20 mA	With Option	629-1
—30	Current Transmitter, 10-50 mA	With Option	630-1

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations

Federal Supply Codes for Manufacturers

Fluke Technical Service Centers — U.S. and Canada

Sales and Service Locations — International

Sales Representatives — U.S. and Canada

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers (Continued)

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

Federal Supply Codes for Manufacturers (Continued)

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

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Replaced by 14433

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Section 8
Schematic Diagrams

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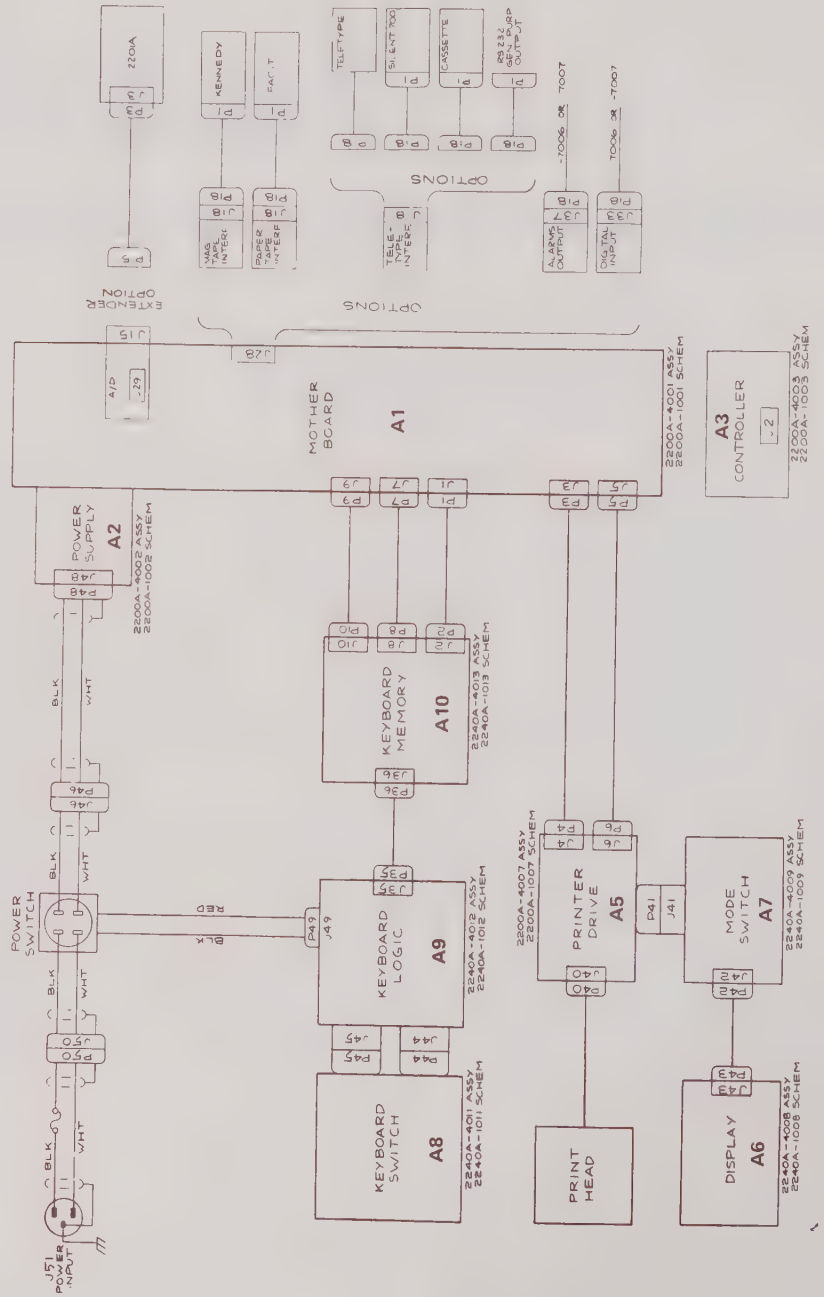

Figure 8-1. System Cable Connections (2240A-1301) (Sheet 1 of 2)

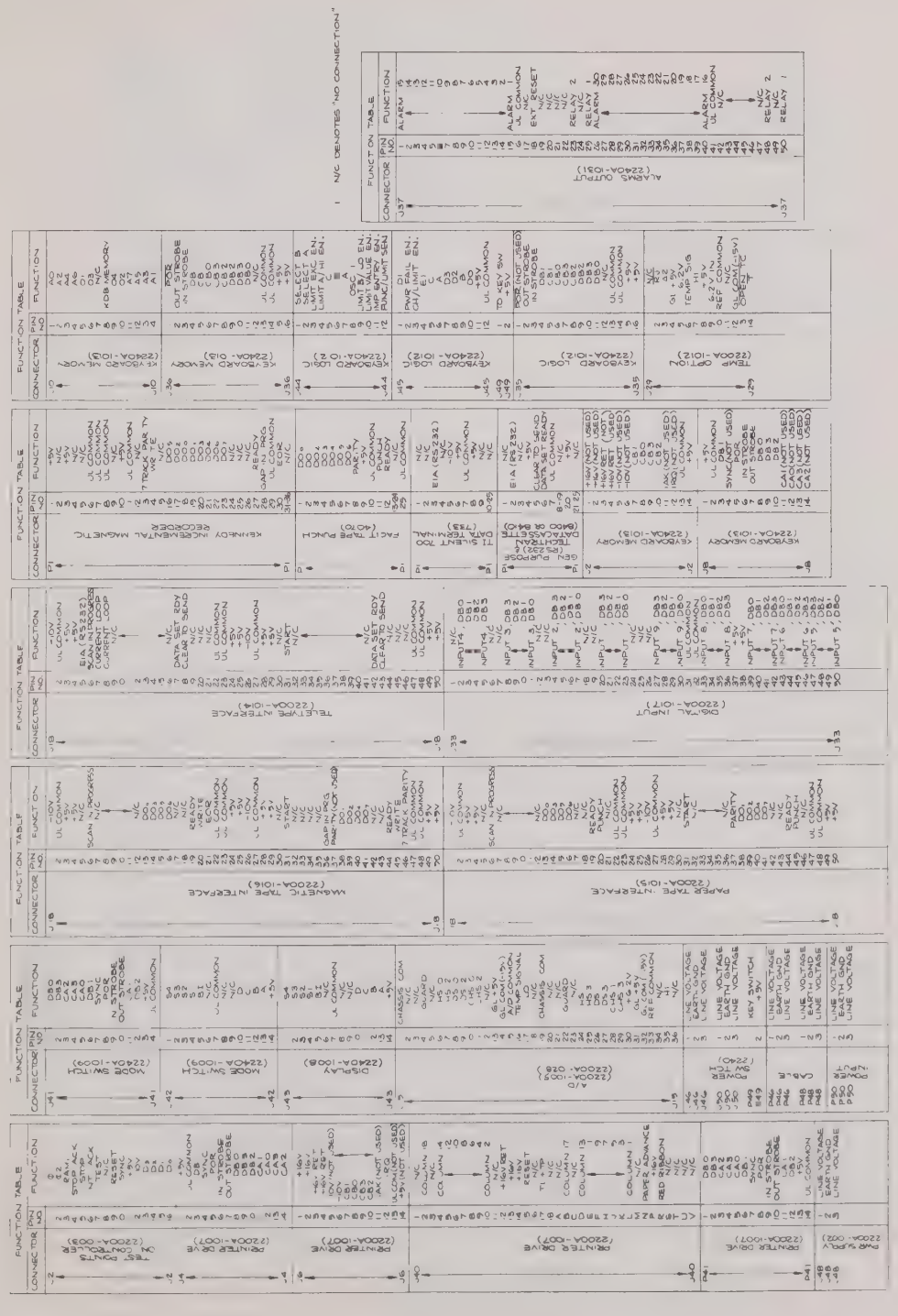

Figure 8-1. System Cable Connections (2240A-1301) (Sheet 2 of 2)

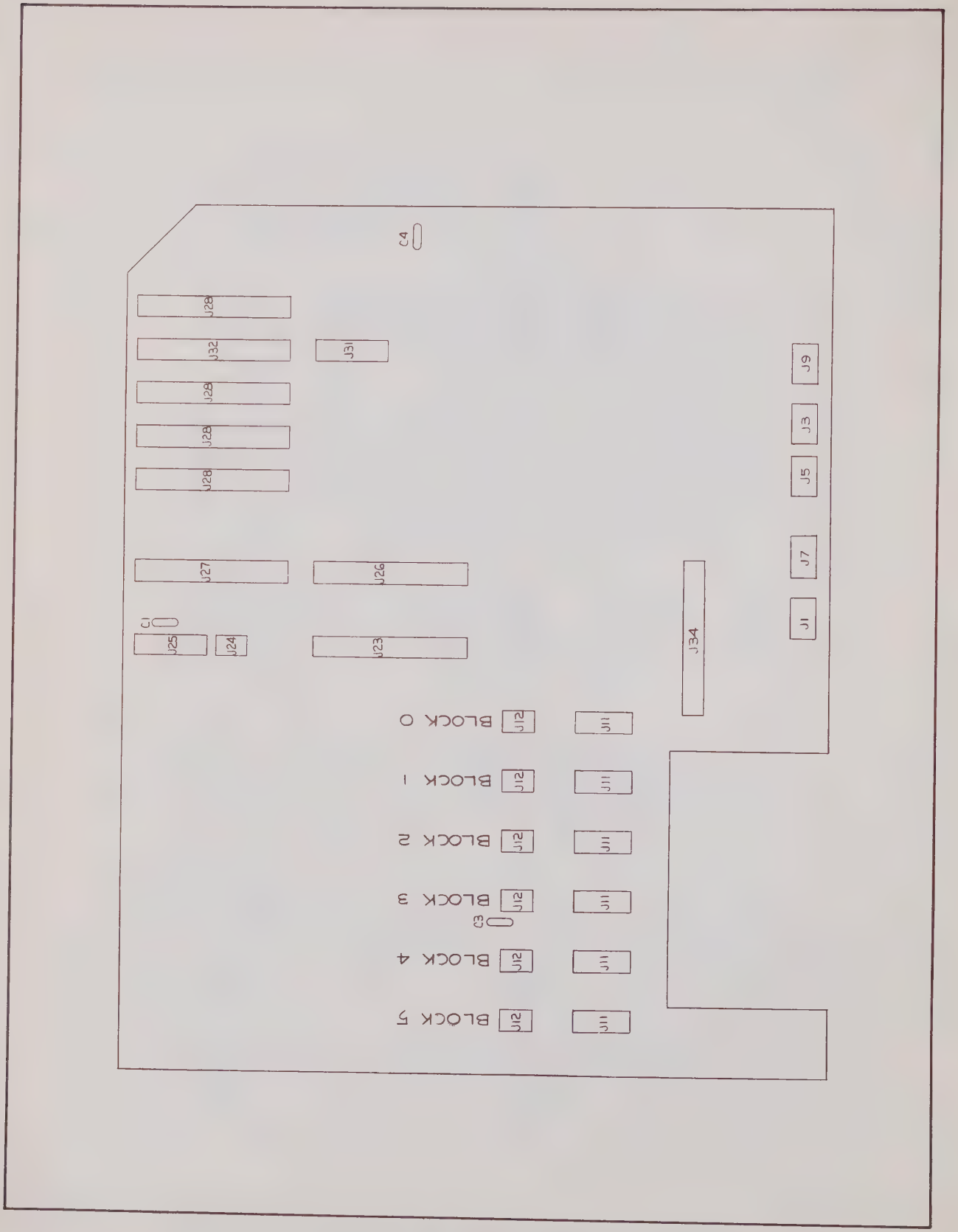

Figure 8-2. A1 Mother Board PCB Assembly (2200A-1001) (Sheet 1 of 2)

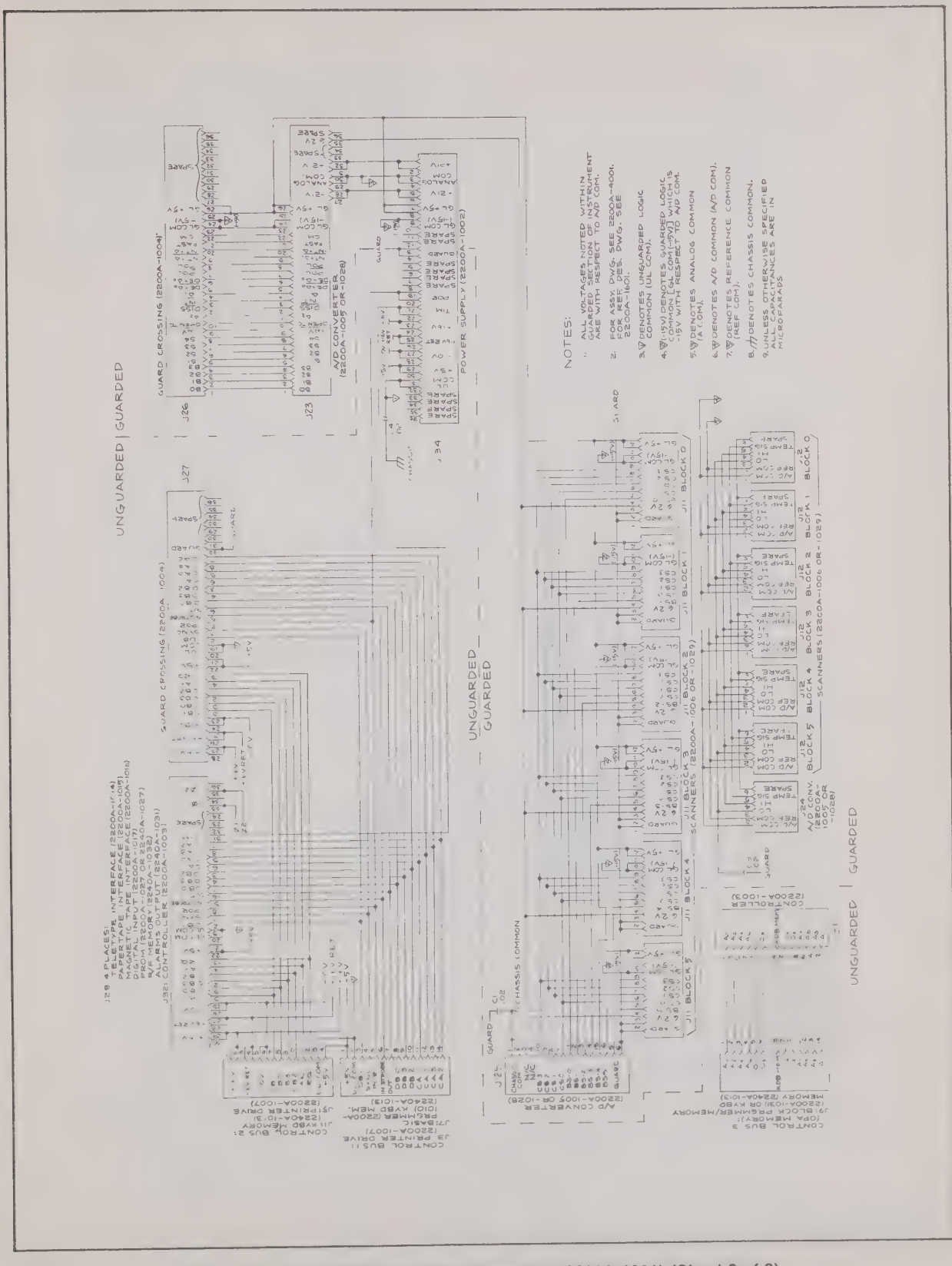
NOTES:
1. ALL VOLTAGES NOTED WITHIN GUARDED SECTION OF INSTRUMENT ARE WITH RESPECT TO A/D COM.
2. FOR ASSY. DWG. SEE 2200A-1001, FOR SCHEMATIES, DWG. SEE 2200A-1601.
3. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).
4. ▽ (5V) DENOTES GUARDED LOGIC COMMON (GL COM (-5V)) WHICH IS -5V WITH RESPECT TO A/D COM.
5. ▽ DENOTES ANALOG COMMON (A COM).
6. ▽ DENOTES A/D COMMON (A/D COM).
7. ▽ DENOTES REFERENCE COMMON (REF COM).
8. // DENOTES CHASSIS COMMON.
9. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCES ARE IN MICROFARADS
UNGUARDED | GUARDED
GUARD CROSSING (2200A-1004)
A/D CONVERTER (2200A-1005 OR-1026)
POWER SUPPLY (2200A-1002)
UNGUARDED
GUARDED
SCANNERS (2200A-1006 OR-1029)
A/D CONV. (2200A-1005 OR -1028)
CONTROLLER (2200A-1003)
CONTROL BUS 3: (OPA MEMORY): J9: BLOCK PROGMEM/MEMORY (2200A-1013) OR KYBD MEMORY (2240A-1013)
CONTROL BUS 2: J7: BASIC PROGMEM (2200A-1010) KYBD MEM. (2240A-1013)
CONTROL BUS 1: J8: PRINTER DRIVE (2200A-1007)
J28 4 PLACES: FEATURE INTERFACE (2200A-1014)
PAPERTAPE INTERFACE (2200A-1015)
MAGNETIC TAPE INTERFACE (2200A-1016)
OPTION (2200A-1027 OR 2240A-1027)
PROM (2200A-1028 OR 2240A-1028)
R/W MEMORY (2240A-1032)
TEST OUTPUT (2200A-1031)
J32: CONTROL CABLE (2200A-1009)
CHASSIS COMMON

Figure 8-2. A1 Mother Board PCB Assembly (2200A-1001) (Sheet 2 of 2)

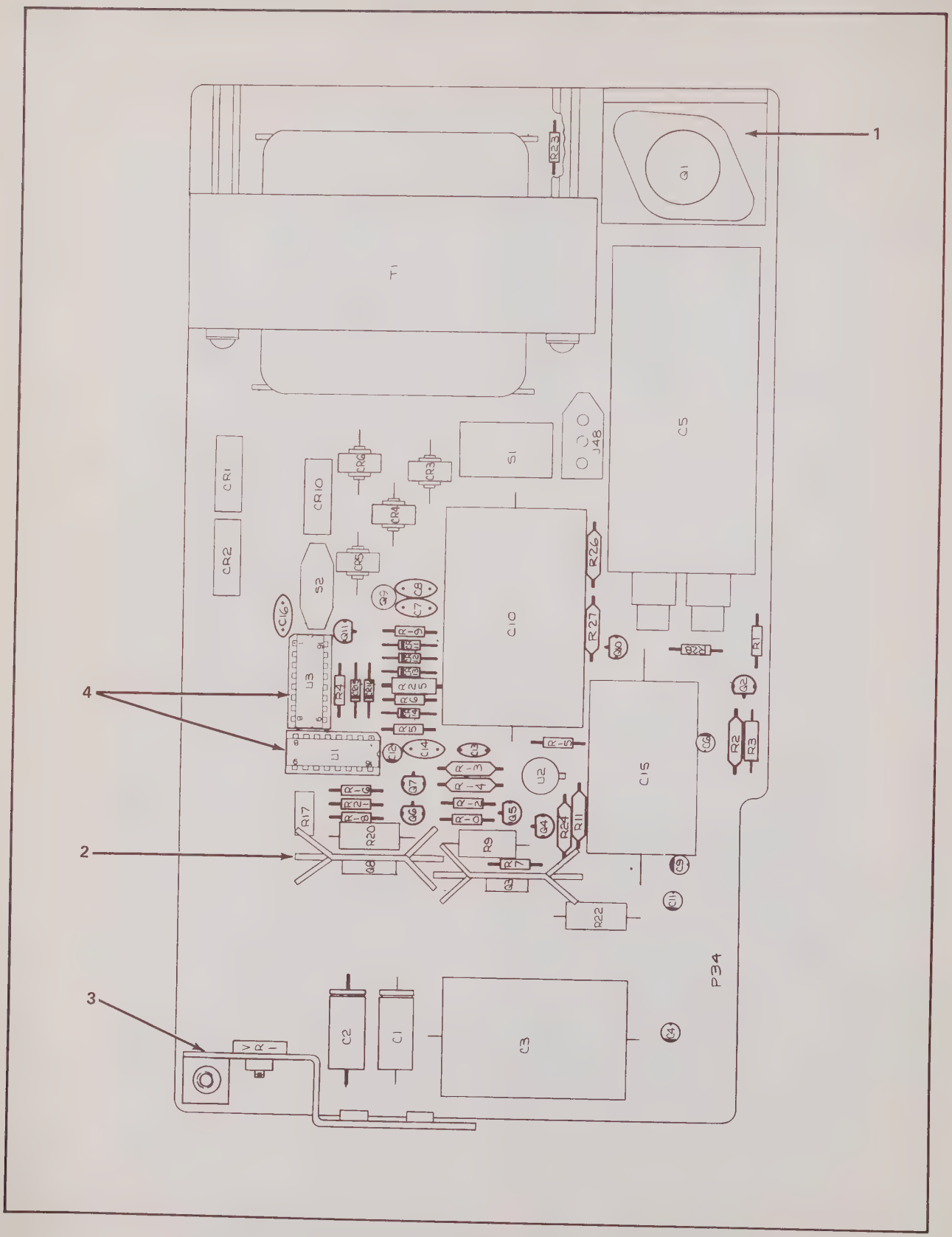

Figure 8-3. A2 Power Supply PCB Assembly (2200A-1002) (Sheet 1 of 2)

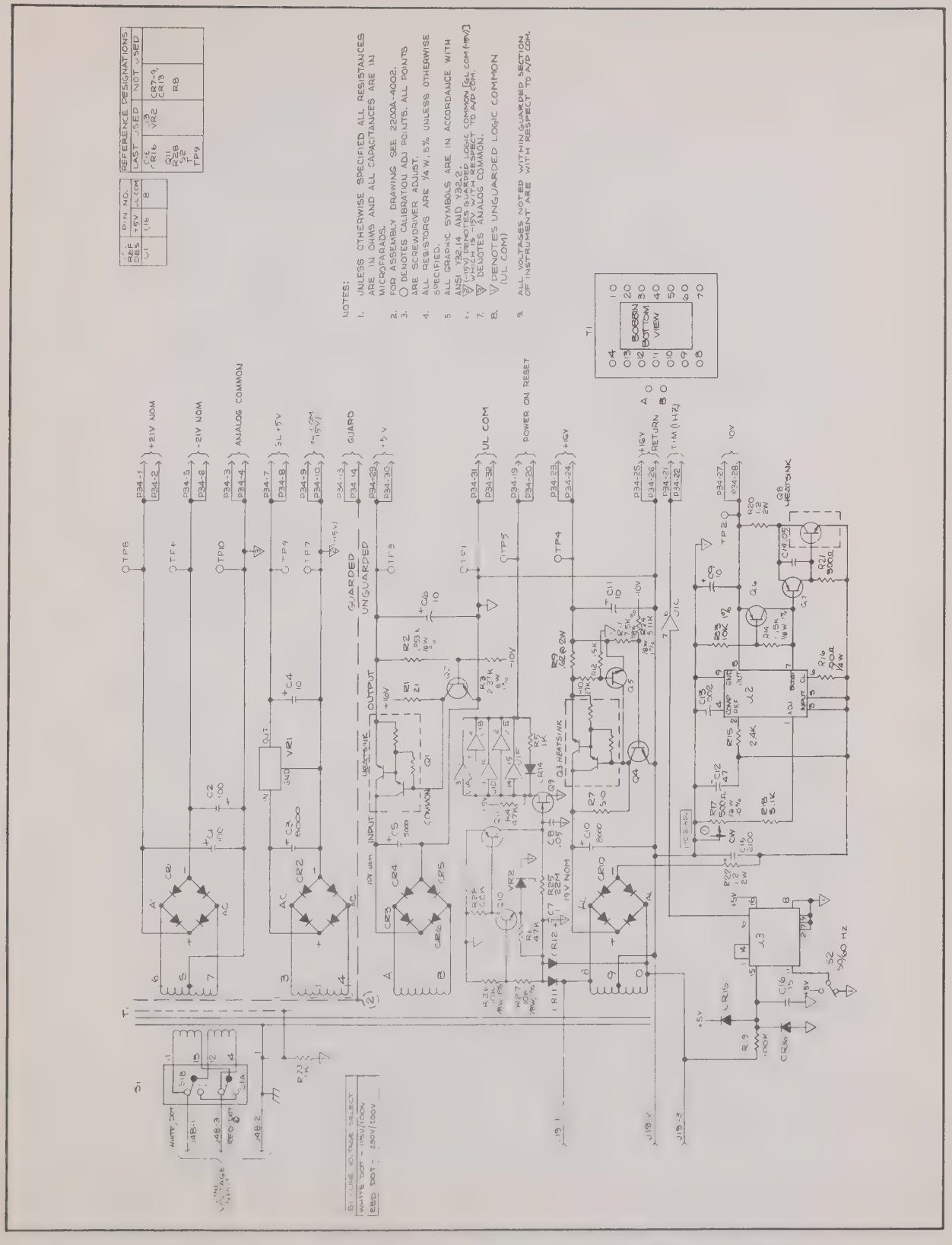

Figure 8-3. A2 Power Supply PCB Assembly (2200A-1002) (Sheet 2 of 2)

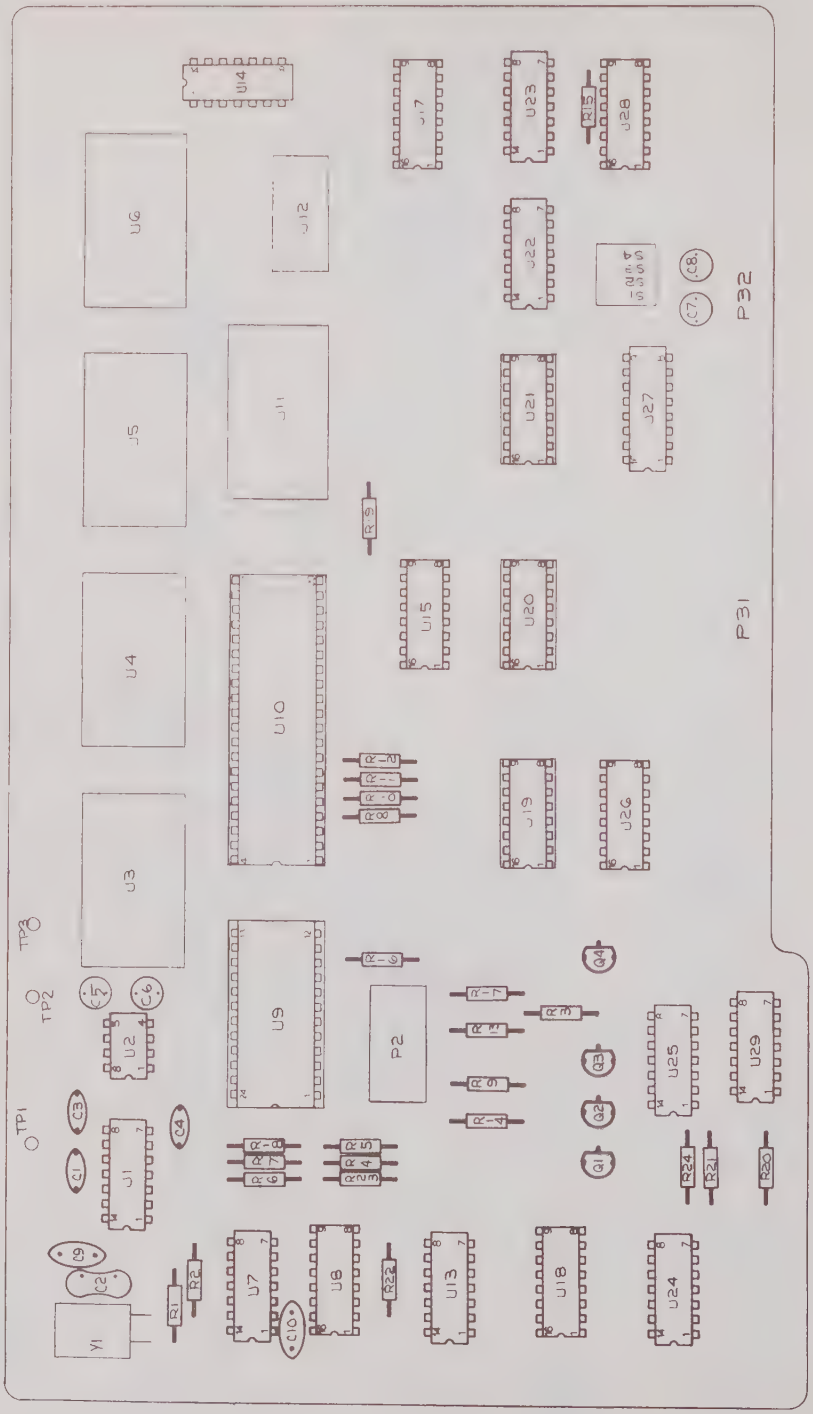

Figure 8-4. A3 Controller PCB Assembly (2200A-1003) (Sheet 1 of 2)

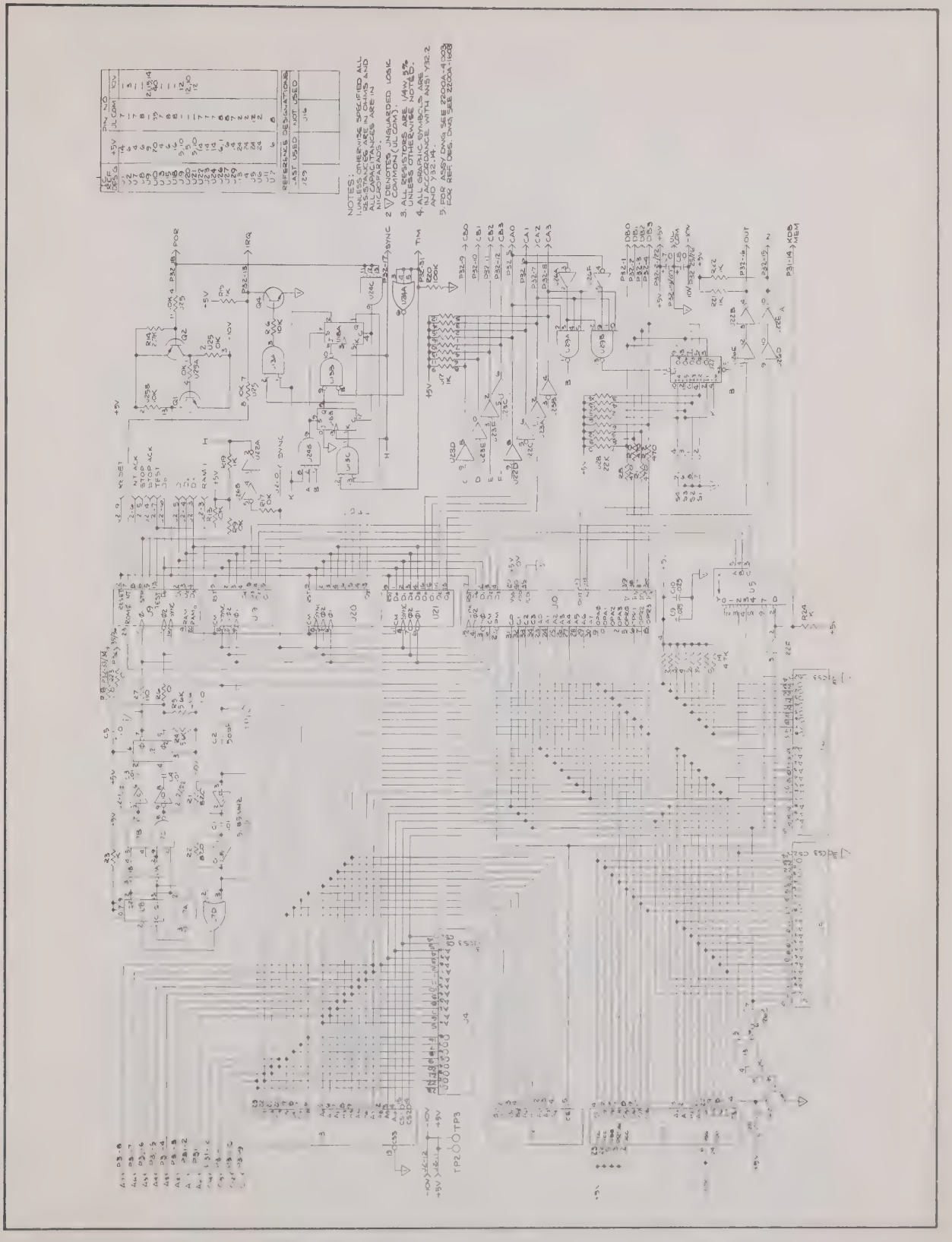

Figure 8-4. A3 Controller PCB Assembly (2200A-1003) (Sheet 2 of 2)

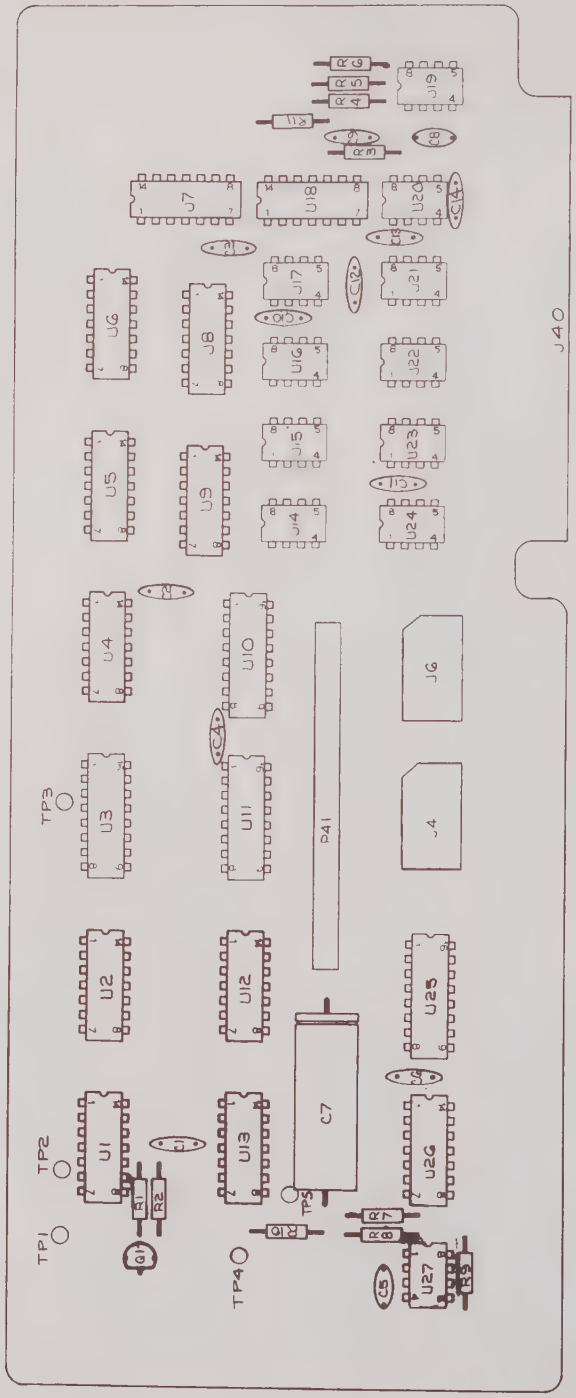

Figure 8-5. A5 Printer Drive PCB Assembly (2200A-1007) (Sheet 1 of 2)

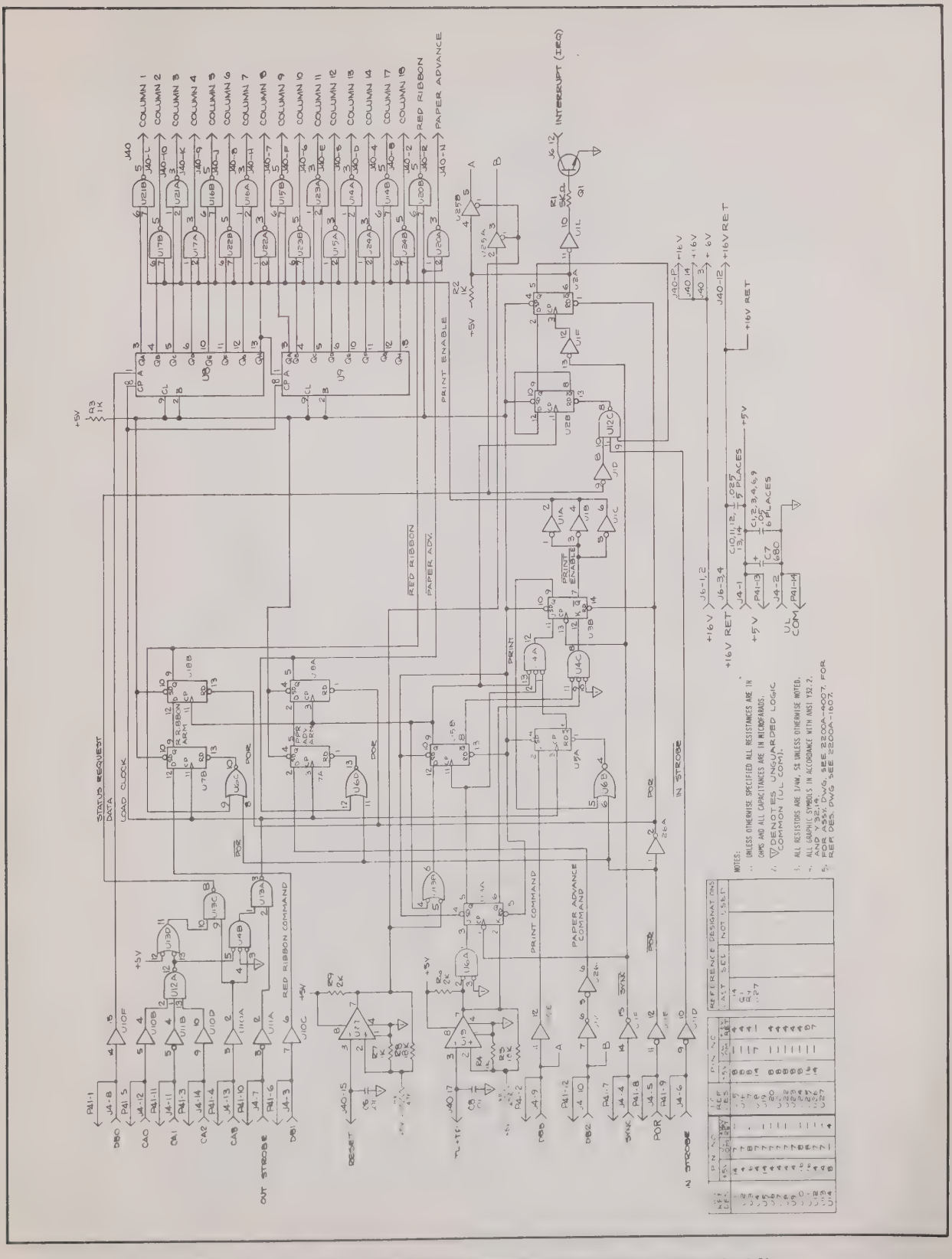

Figure 8-5. A5 Printer Drive PCB Assembly (2200A-1007) (Sheet 2 of 2)

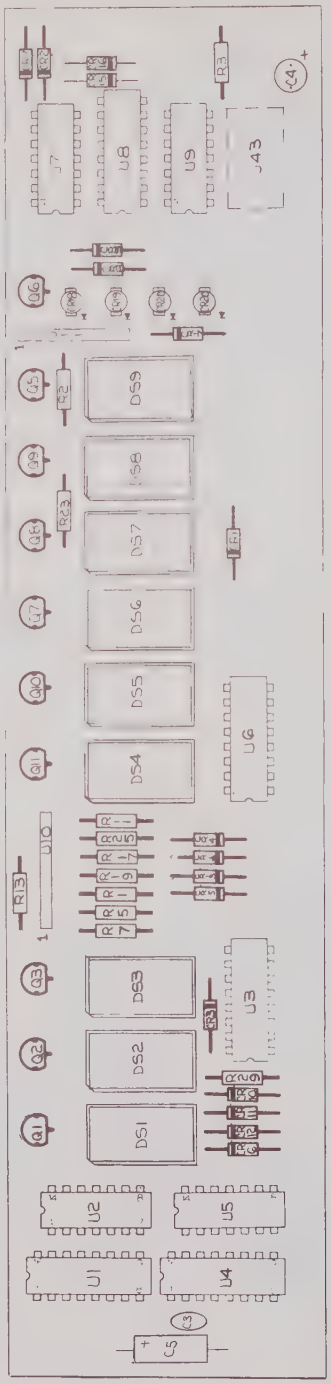

Figure 8-6. A6 Display PCB Assembly (2240A-1008) (Sheet 1 of 2)

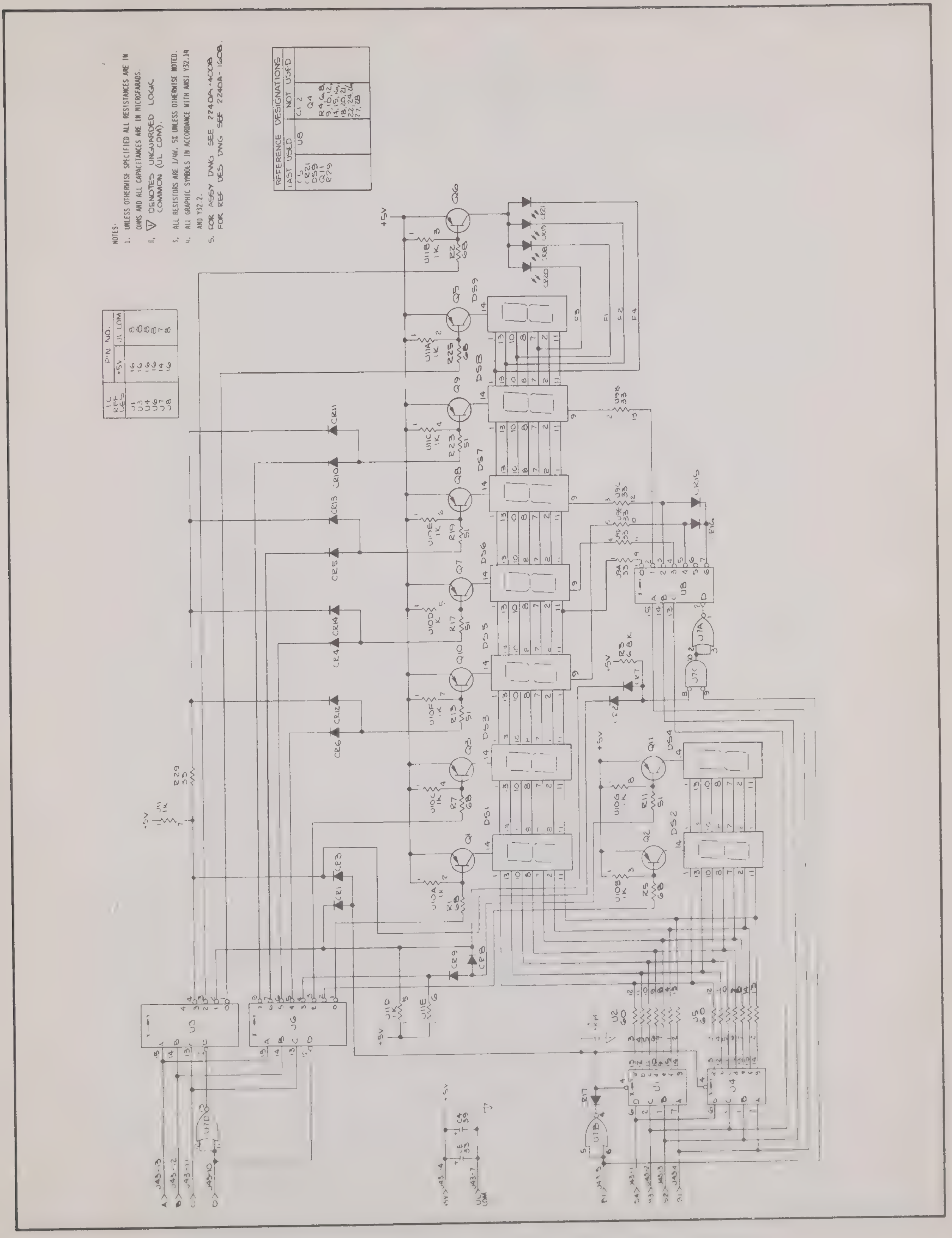
NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. DENOTES UNGUARDED LOGIC COMMON (UL COM).
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. FOR ASSY DWG SEE 2240A-4008
FOR REF DES DWG SEE 2240A-1608.
REFERENCE DESIGNATIONS
LAST USED
NOT USED
U8
Q4
PIN NO.
+5V
UL COM
DS1
DS2
DS3
DS4
DS5
DS6
DS7
DS8
DS9
U3
U6
U8
J1A
J1B
J1C
J1D
Figure labels: A, B, C, D, +5V, UL COM

Figure 8-6. A6 Display PCB Assembly (2240A-1008) (Sheet 2 of 2)

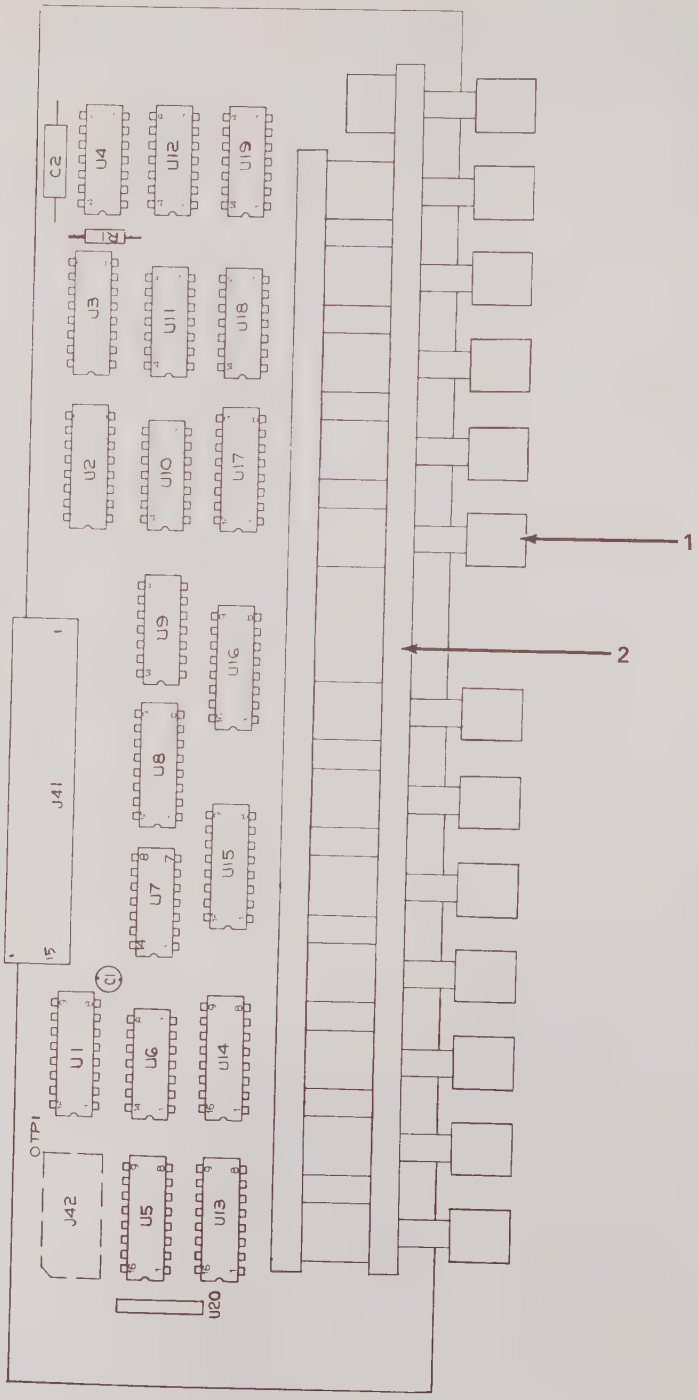

Figure 8-7. A7 Mode Switch PCB Assembly (2240A-1009) (Sheet 1 of 2)

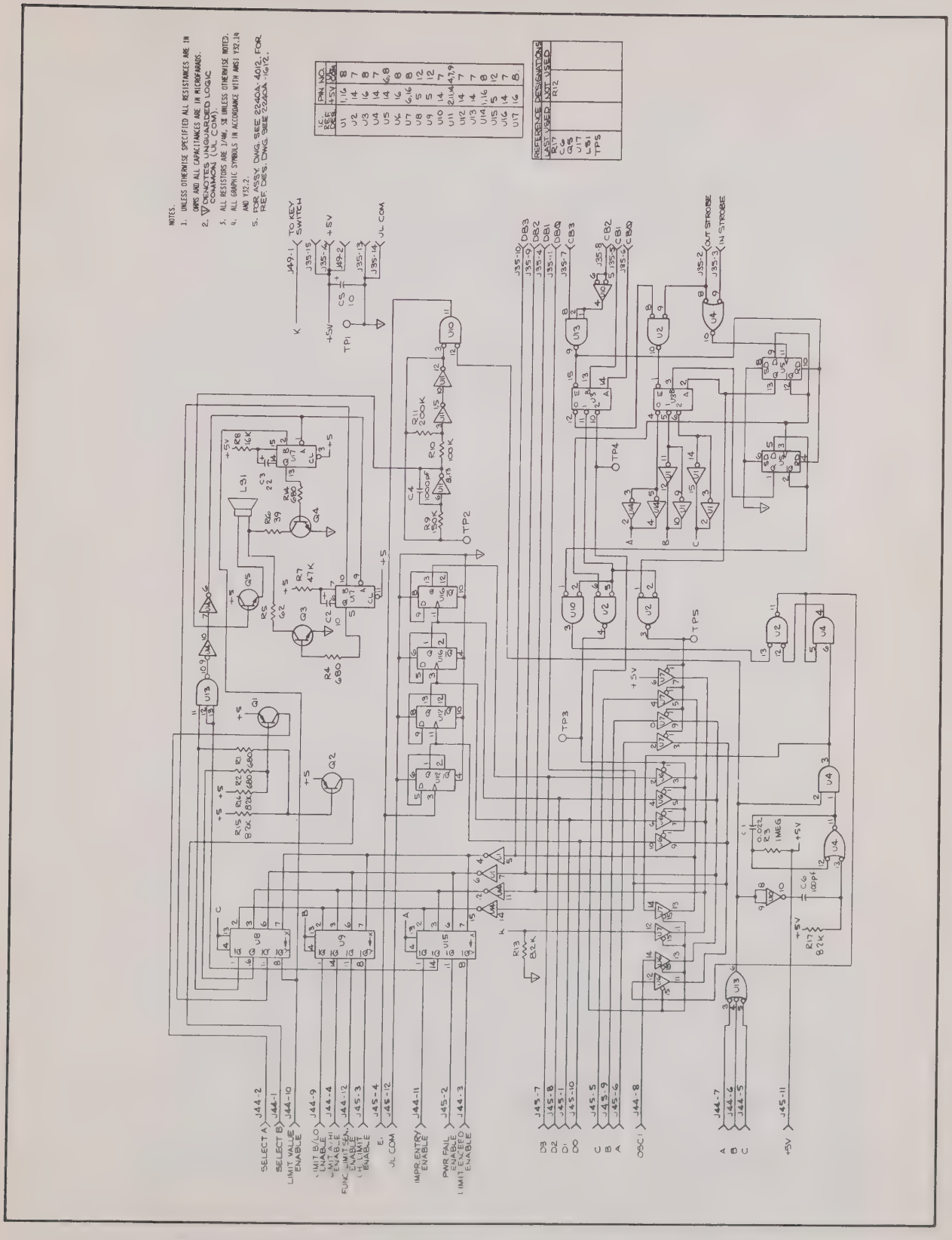

Figure 8-9. A9 Keyboard Logic PCB Assembly (2240A-1012) (Sheet 2 of 2)

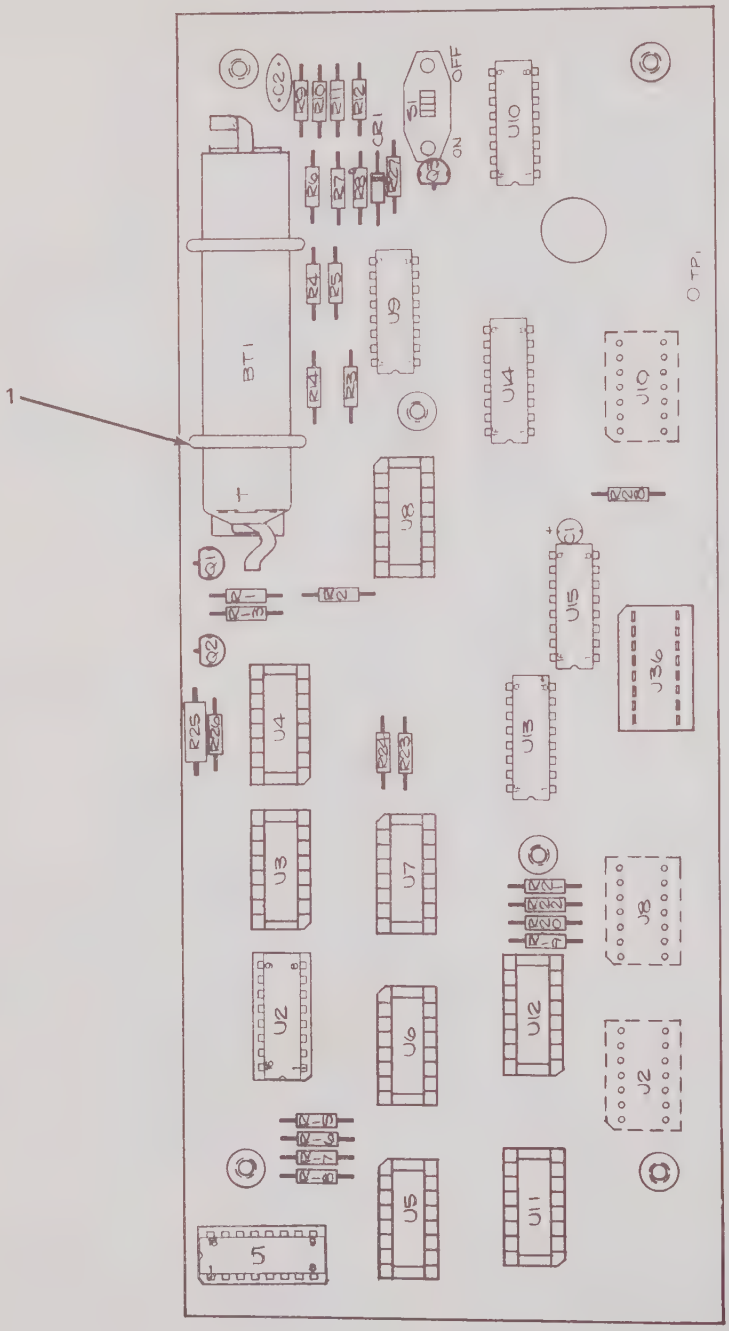

Figure 8-10. A10 Keyboard Memory PCB Assembly (2240A-1013) (Sheet 1 of 2)

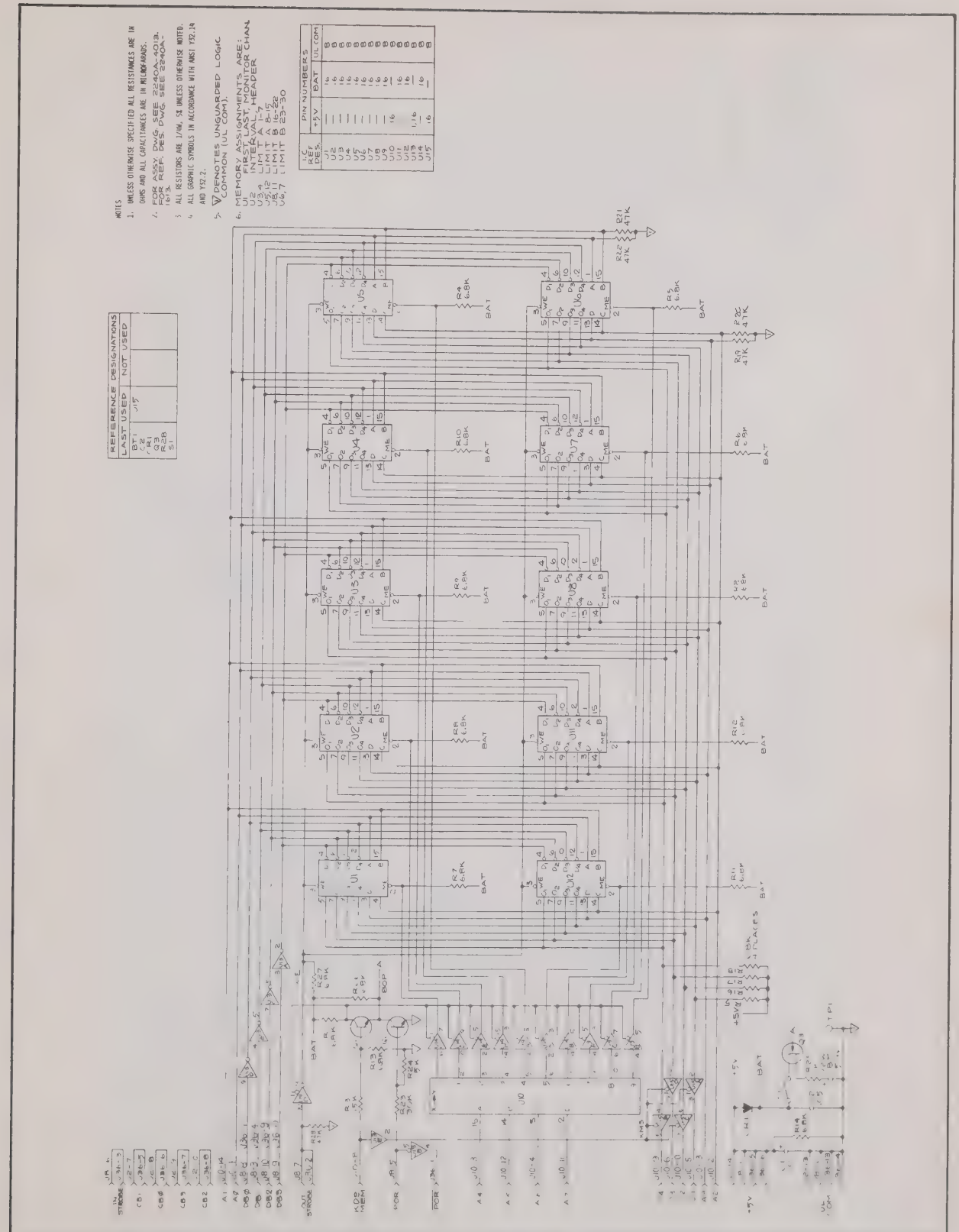

Figure 8-10. A10 Keyboard Memory PCB Assembly (2240A-1013) (Sheet 2 of 2)

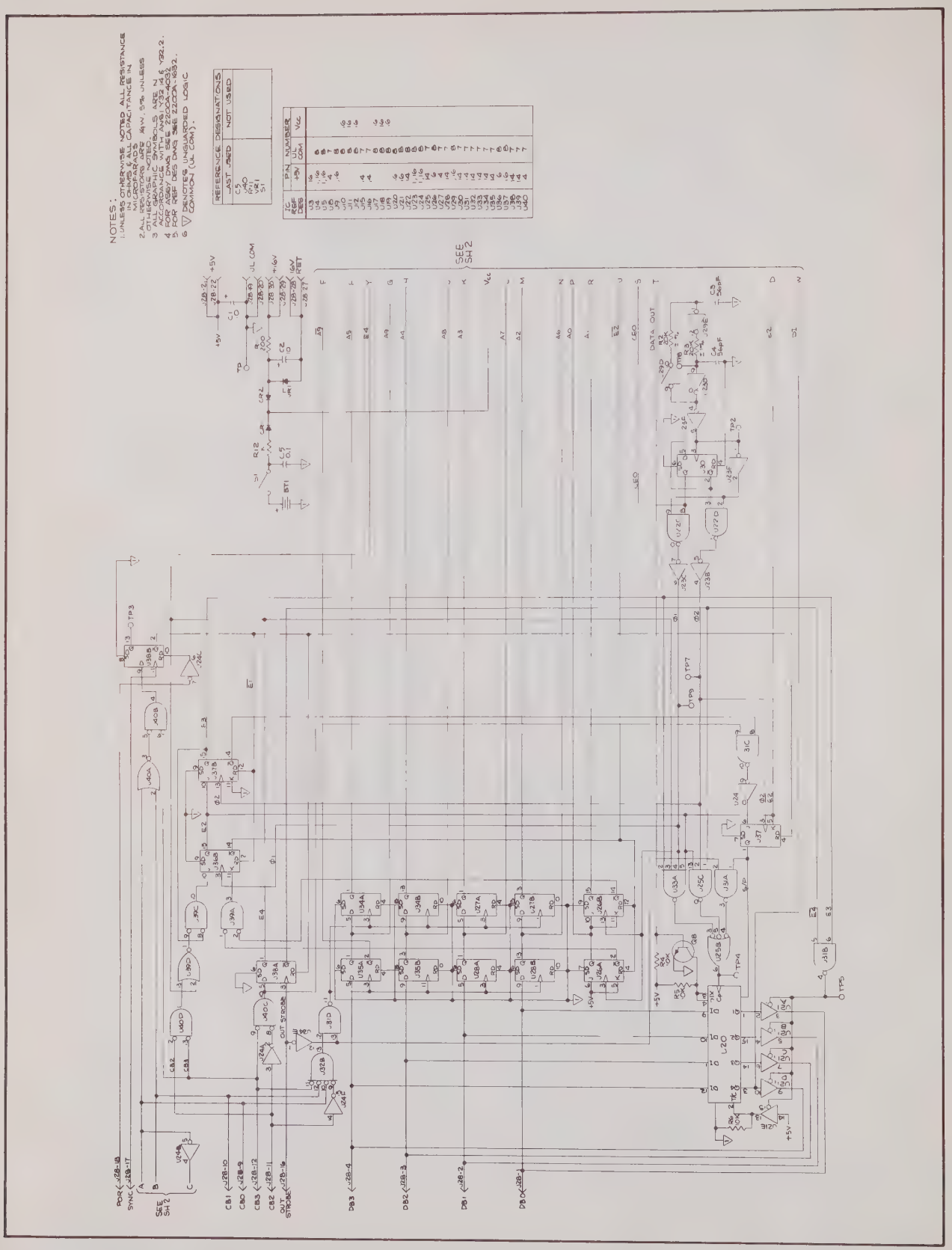

Figure 8-11. A11 Range and Function Memory PCB Assembly (2240A-1032) (Sheet 1 of 3)

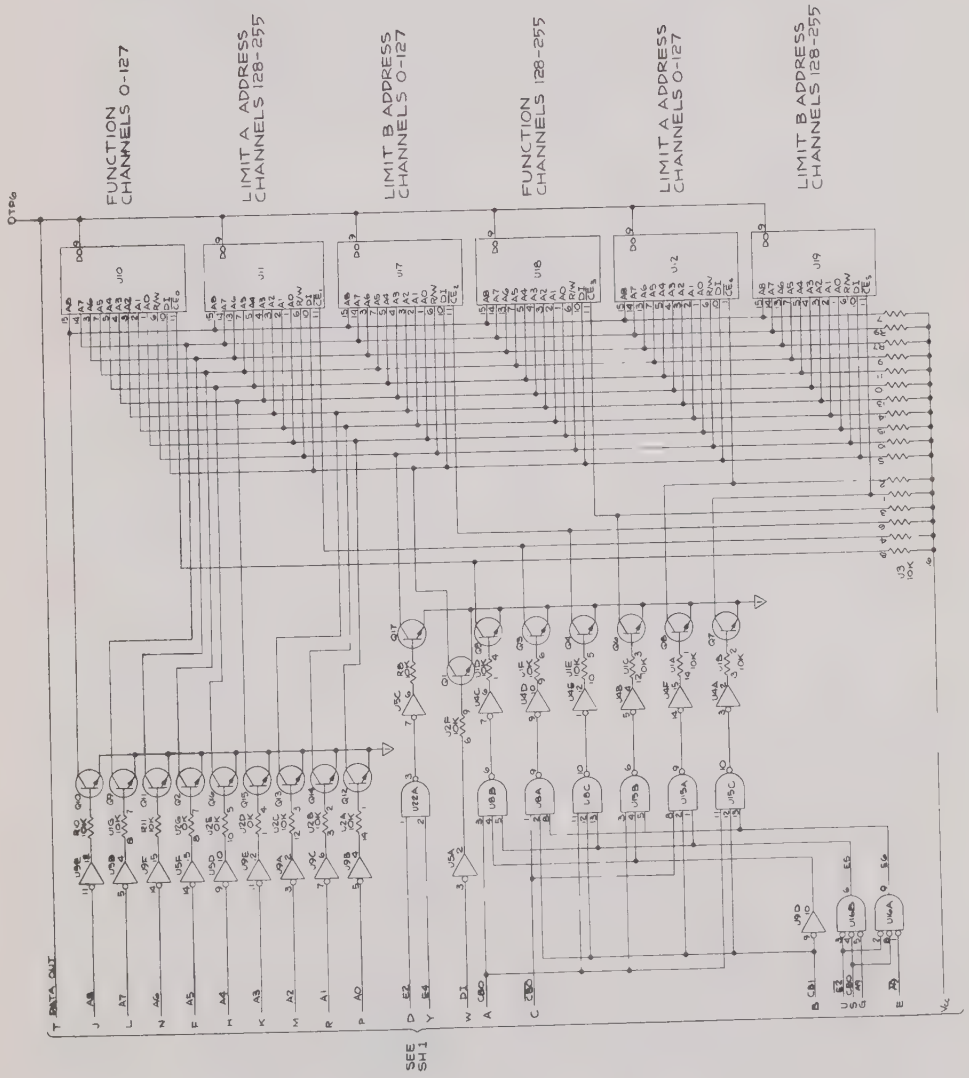

Figure 8-11. A11 Range and Function Memory PCB Assembly (2240A-1032) (Sheet 2 of 3)

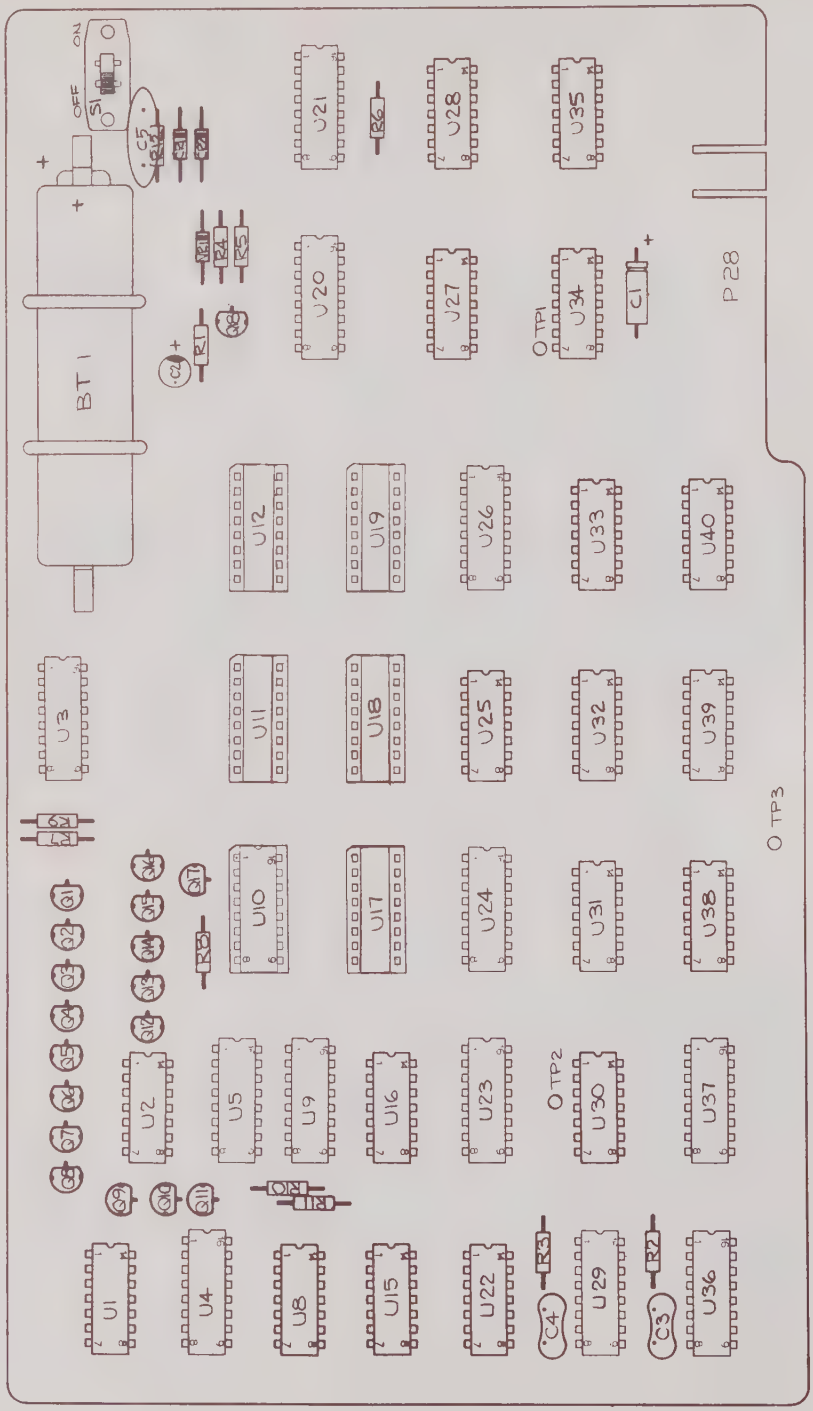

Figure 8-11. A11 Range and Function Memory PCB Assembly (2240A-1032) (Sheet 3 of 3)

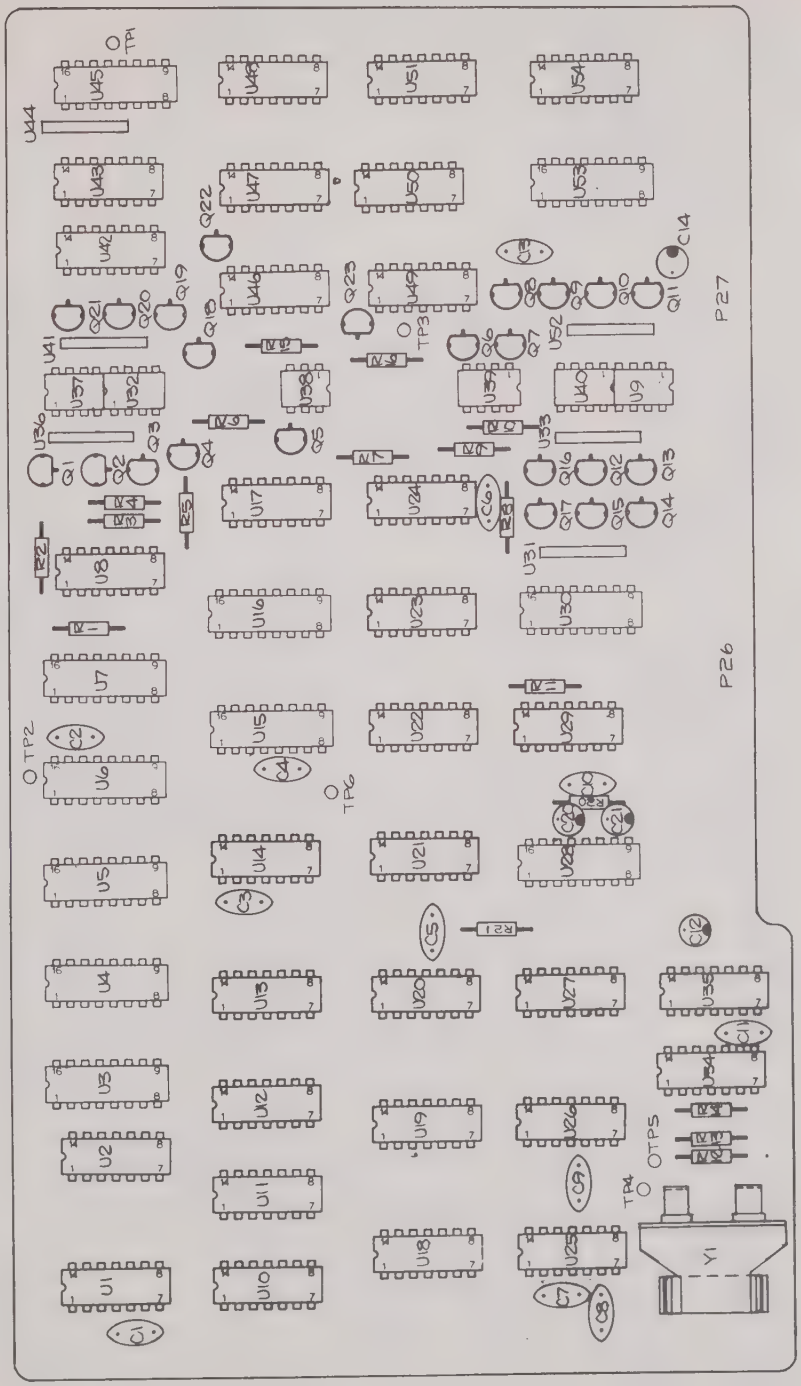

Figure 8-12. A4 Guard Crossing PCB Assembly (2200A-1004) (Sheet 1 of 3)

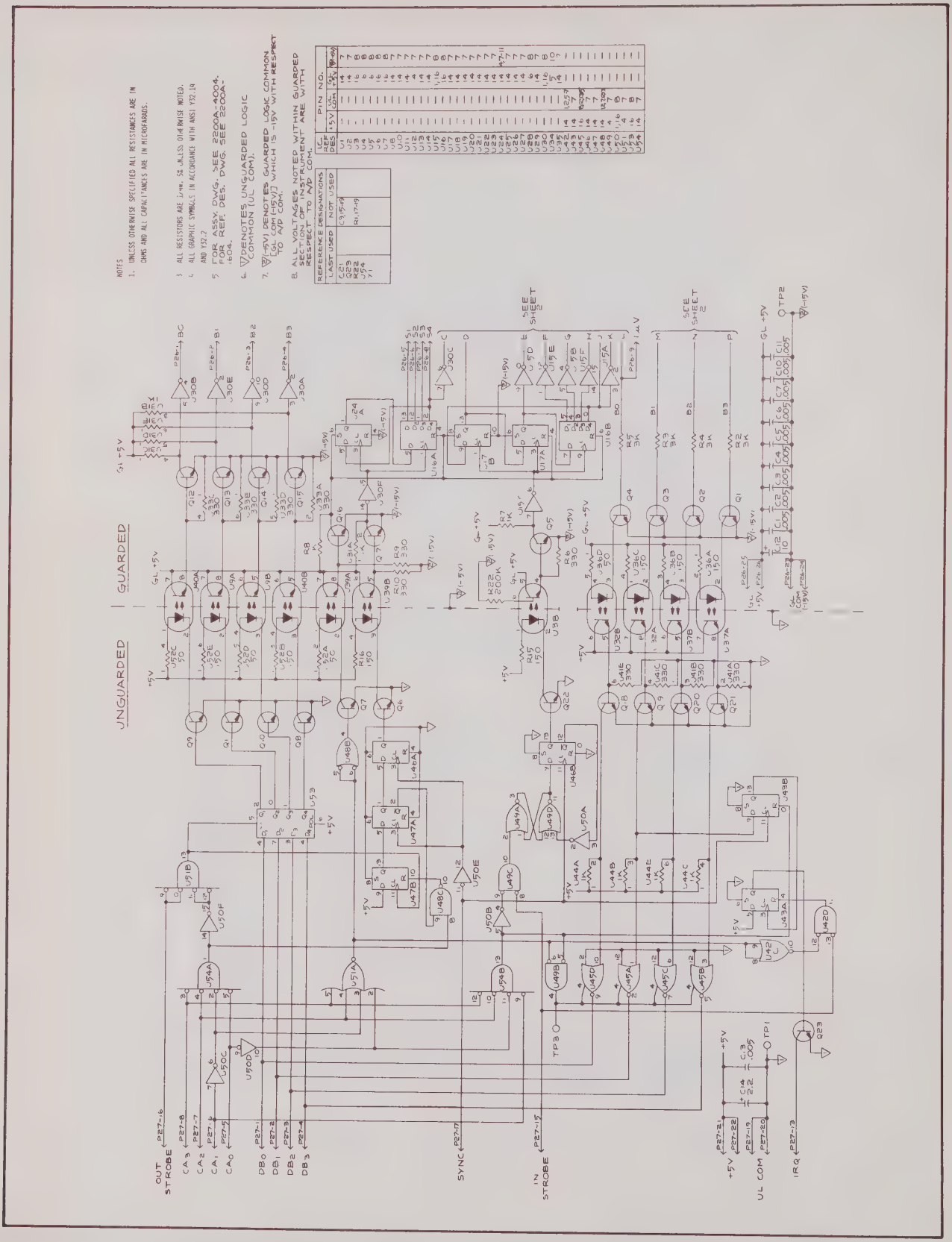
NOTES
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2
5. FOR ASSY. DWG. SEE 2200A-4004. FOR REF. DES. DWG. SEE 2200A-1604.
6. ▽DENOTES UNGUARDED LOGIC COMMON (UL COM).
7. ▽(-15V) DENOTES GUARDED LOGIC COMMON (GL COM (-15V)) WHICH IS -15V WITH RESPECT TO A/D COM.
8. ALL VOLTAGES NOTED WITHIN GUARDED ASSEMBLY ARE WITH RESPECT TO A/D COM.
REFERENCE DESIGNATIONS
LAST USED | NOT USED
C21 | C3-19
Q23 | R1-19
R24 |
V1 |
IC REF DES | PIN NO. +5V | GL +5V | GND
U1 | 1 | 14 | 7
U2 | - | 16 | 8
U3 | - | 16 | 8
U4 | - | 16 | 8
U5 | - | 16 | 8
U6 | - | 16 | 8
U7 | - | 16 | 8
U8 | - | 16 | 8
U10 | - | 16 | 8
U11 | - | 16 | 8
U12 | - | 16 | 8
U13 | - | 16 | 8
U14 | - | 16 | 8
U15 | - | 16 | 8
U16 | - | 16 | 8
U17 | - | 16 | 8
U18 | - | 16 | 8
U19 | - | 16 | 8
U20 | - | 16 | 8
U21 | - | 16 | 8
U22 | - | 16 | 8
U23 | - | 16 | 8
U24 | - | 16 | 8
U25 | - | 16 | 8
U26 | - | 16 | 8
U27 | - | 16 | 8
U28 | - | 16 | 8
U29 | - | 16 | 8
U30 | - | 16 | 8
U31 | - | 16 | 8
U32 | - | 16 | 8
U33 | - | 16 | 8
U34 | - | 16 | 8
U35 | - | 16 | 8
U36 | - | 16 | 8
U37 | - | 16 | 8
U38 | - | 16 | 8
U39 | - | 16 | 8
U40 | - | 16 | 8
U41 | - | 16 | 8
U42 | - | 16 | 8
U43 | - | 16 | 8
U44 | - | 16 | 8
U45 | - | 16 | 8
U46 | - | 16 | 8
U47 | - | 16 | 8
U48 | - | 16 | 8
U49 | - | 16 | 8
U50 | 16 | 8 | 8
U51 | 16 | 8 | 8
U52 | 16 | 8 | 8
U53 | 16 | 8 | 8
U54 | 16 | 8 | 8
GUARDED
UNGUARDED
SEE SHEET 1
SEE SHEET 2
OUT STROBE
CA3
CA2
CA1
CA0
DB0
DB1
DB2
DB3
SYNC
IN STROBE
+5V
UL COM
IRQ
TP1
TP2
TP3

Figure 8-12. A4 Guard Crossing PCB Assembly (2200A-1004) (Sheet 2 of 3)

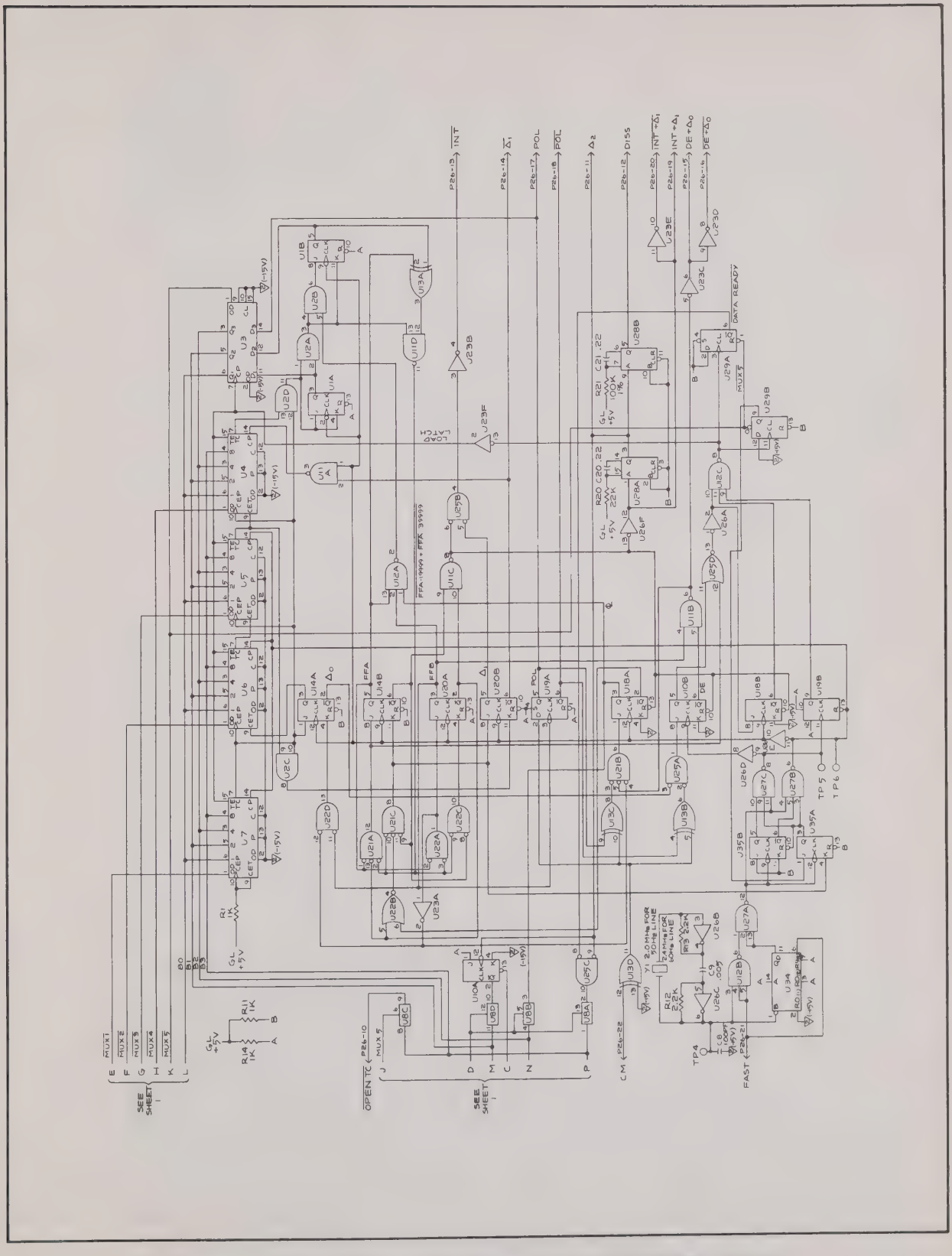

Figure 8-12. A4 Guard Crossing PCB Assembly (2200A-1004) (Sheet 3 of 3)

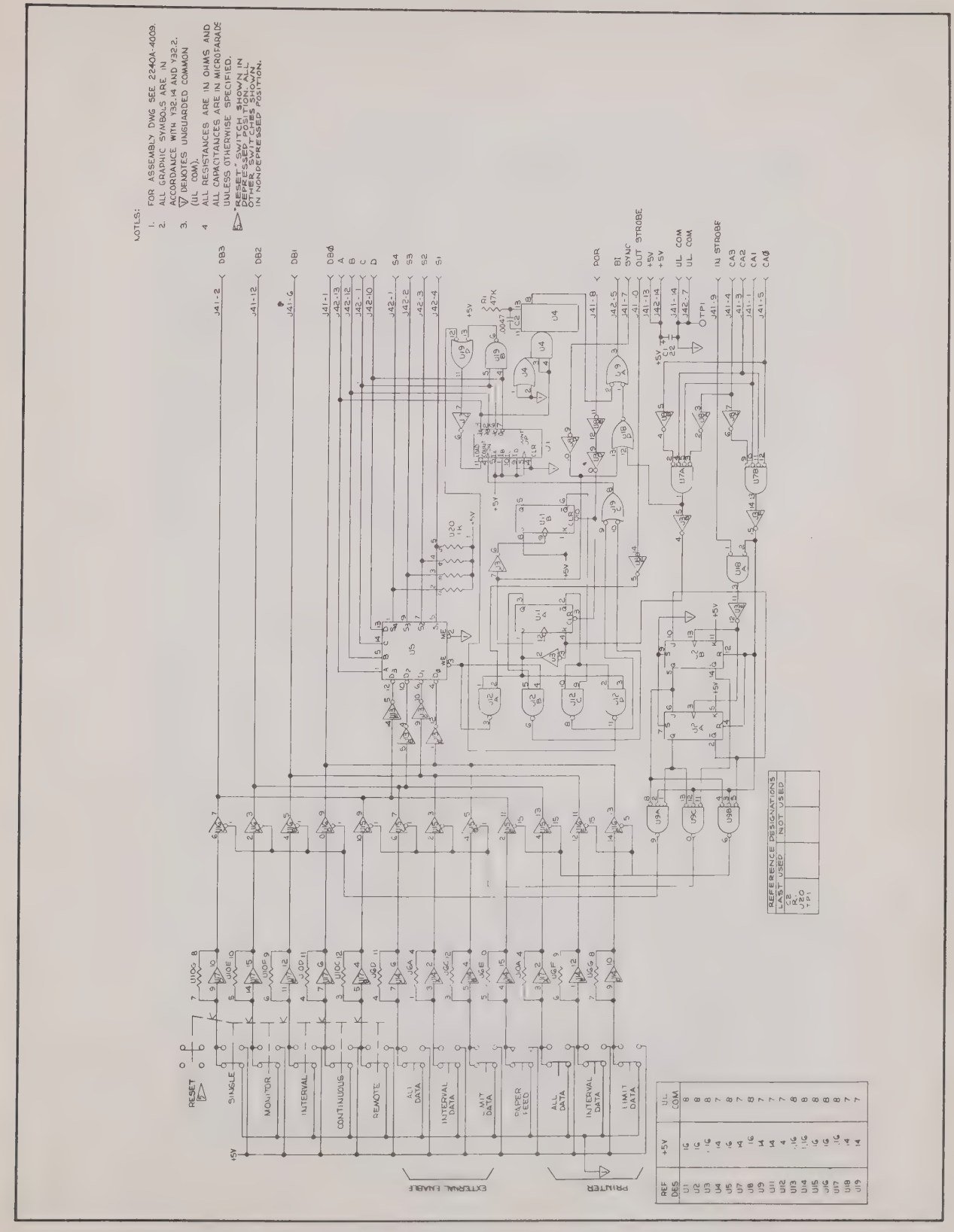

Figure 8-7. A7 Mode Switch PCB Assembly (2240A-1009) (Sheet 2 of 2)

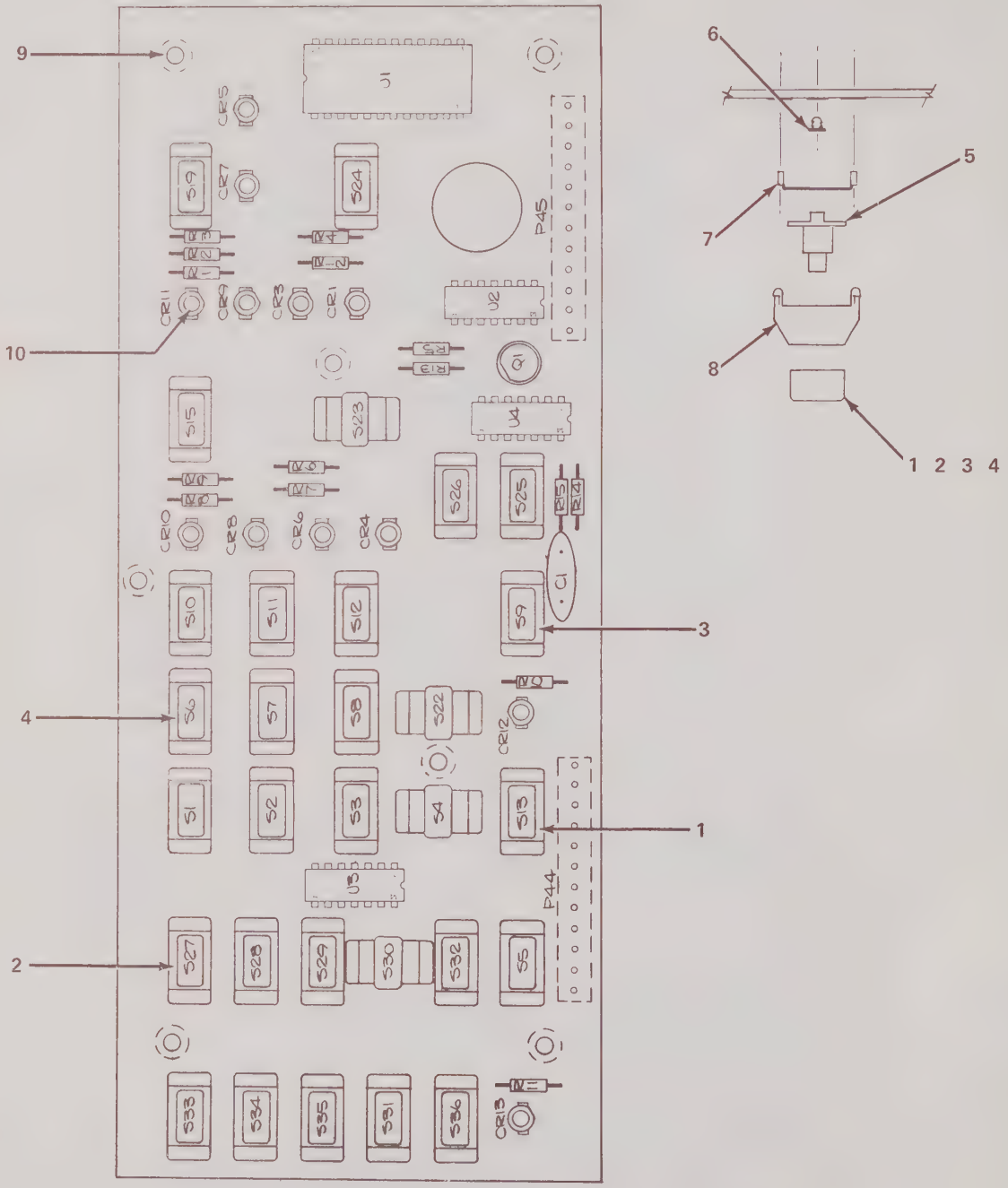

Figure 8-8. A8 Keyboard Switch PCB Assembly (2240A-1011) (Sheet 1 of 2)

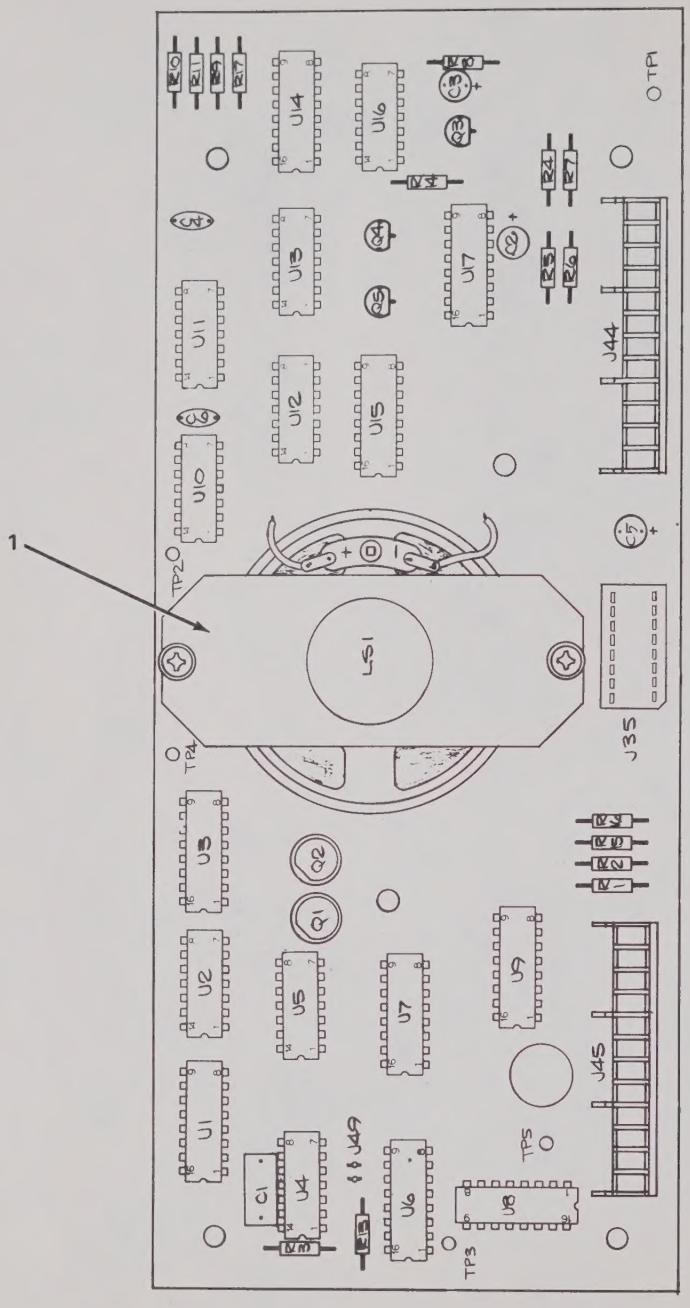

Figure 8-9. A9 Keyboard Logic PCB Assembly (2240A-1012) (Sheet 1 of 2)

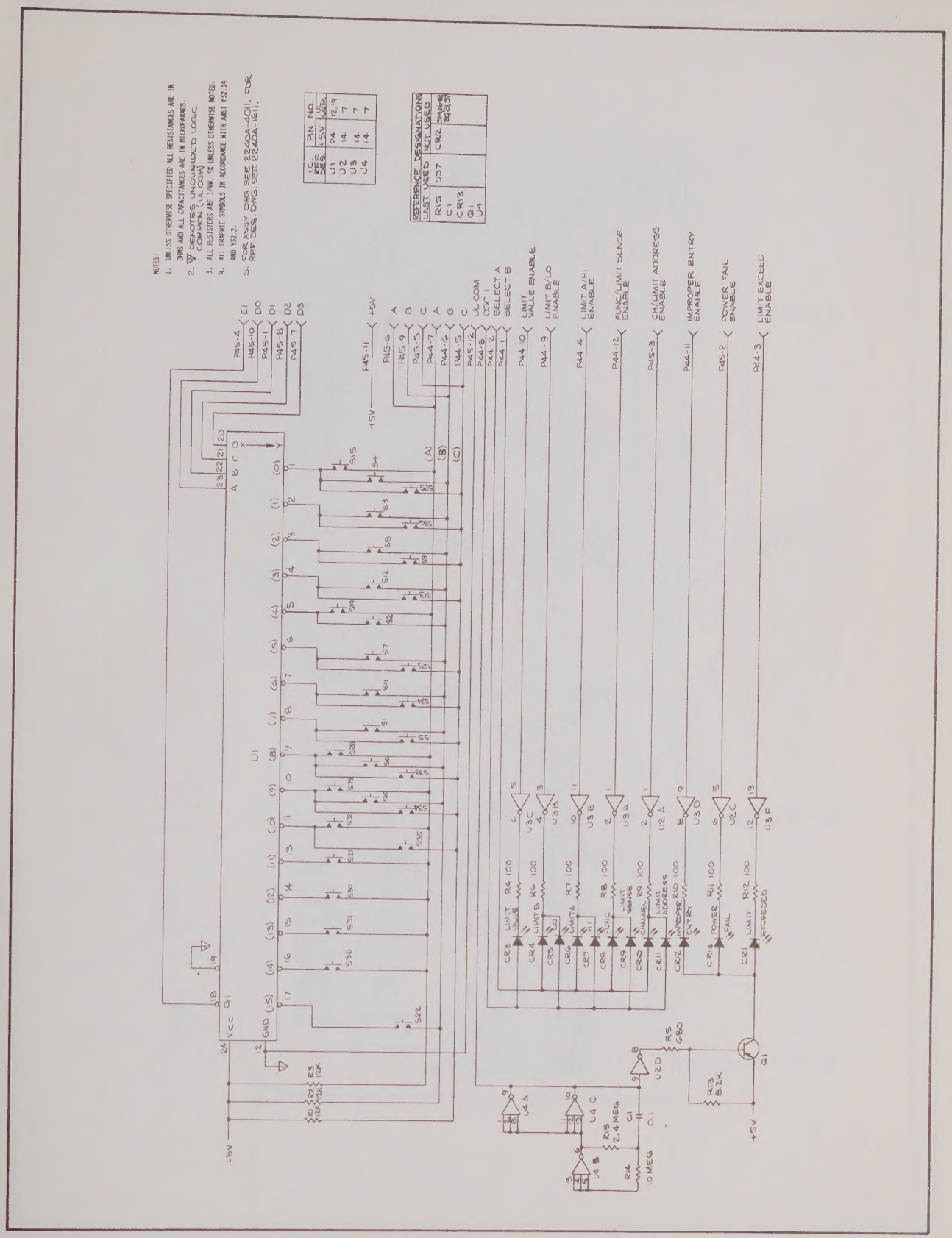

Figure 8-8. A8 Keyboard Switch PCB Assembly (2240A-1011) (Sheet 2 of 2)

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